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Remarks on the Rifle. By WILLIAM N. JEFFERS, U. S. N.

The attention of the military and sporting world has been attracted, and its inventive genius stimulated, by the published reports of the extraordinary performances of the needle gun, and Minié rifle. These reports were supposed to be greatly exaggerated; but a repetition of these experiments under other circumstances, has proved that, although the results were not in all respects such as to warrant an abandonment of arms which have passed the ordeal of service, a weapon constructed on this principle is in most respects superior to that which has for so long a period formed the armament of a portion of the troops of all civilized nations. Notwithstanding these disadvantages, there are persons who consider accuracy preferable to simplicity, and who do not doubt that the rifle, in some of its forms, must ultimately supersede the smooth bore, for warlike, as it already has for sporting purposes. But what are the conditions to be fulfilled in making a perfect rifle? This is a problem of difficult solution; perhaps, by collating some experiments which have been made at various times, by order of different governments, we may be more successful in our endeavors to ascertain in what respects these new arms are superior to the old, and be saved the trouble of experimenting ourselves to ascertain results already known.

In firing a musket or other smooth bored arm, there are two causes which affect the ball most injuriously, and cause it to deviate from the line of aim.

The first cause is, that the ball not being either perfectly spherical or perfectly homogeneous, the centre of gravity does not coincide with the centre of figure; consequently the resistance experienced during its flight is not directly opposed to the motion of the centre of gravity.

The second, that the ball generally has a rotary motion on some axis, produced either in the barrel or after it has left it. *In the barrel*, if the impulse of the powder is not in the direction of the centre of gravity of the ball, (an effect similar to that produced by striking a billiard ball out of line,) or by friction against the interior. *Out of the barrel*, because the resistance of the atmosphere is seldom directly opposed to the motion of the centre of gravity. Experiment proves that the rotation always exists; for if a mark is placed on the ball, and that mark placed outward in the barrel, upon firing into a soft substance it will be found that the marked spot occupies every conceivable position in the target.

The existence of an independent and uncertain rotation being proved, it is necessary that this motion should be annulled. This is effected by tracing upon the interior of the barrel spiral grooves, into which the ball is forced by ramming, or otherwise; the ball, upon the charge being fired, follows the direction of the grooves and issues from the barrel in the manner of a short screw of several threads from an elongated nut, the axis of the ball coincident with that of the barrel; this causes a rotation which preserves the axis constantly parallel to its initial direction during the time of flight, presents any inequalities of weight or of figure alternately to the right and the left, above and below the line of flight, thus equalizing the causes of deviation. This last, however, is not strictly true; for the causes of deviation are more energetic nearer the muzzle, consequently, if the progressive velocity is very great, while that of rotation is but feeble, the resistances are not equal at the points where the inequalities are on opposite sides of the axis, and a deviation will occur. Rifling the bore, therefore, diminishes, but does not entirely overcome, the deviating forces; in fact, it introduces certain deviations, small in amount, but peculiar to itself, which will be hereafter noticed.

It is a known and generally admitted fact, that by diminishing the windage of the musket, (*windage* is the difference between the diameters of the barrel and the ball,) we increase the accuracy; taking into consideration the preceding facts, some persons have expressed doubts as to the necessity of rifling the bore, and have asserted that by causing the windage to entirely disappear, that is, *forcing* the ball, as great a degree of accuracy can be attained as with the rifle; experiments made with smooth bores, and the same barrels afterwards rifled, proved conclusively that the rifle is greatly superior in accuracy.

The theory of the effect of rifling would also appear to render unnecessary any experiments upon straight grooves, since they cannot cause the ball to rotate; nevertheless, comparisons were made, and the results found to differ but little from those obtained with the smooth bore, and of course greatly inferior to the rifle.

Having thus determined that for accuracy at considerable distances, it

was necessary to adopt the principle of the rifle, a series of experiments was made to determine—

The Mode of Loading.—Loading at the breech. This mode is the oldest known, and has several advantages; the principal are, an increased range and accuracy, and less recoil on account of the reduction of the charge; to these advantages we may add, when the mechanism for closing the breech is well arranged, facility and rapidity of firing, the importance of which is greatly exaggerated by inventors, but which is not without real value, are greatly increased. Unfortunately, it appears difficult to combine all these advantages with strength and simplicity, and above all, capability of furnishing prolonged service under the ordinary circumstances of a war.

The Prussian needle gun is one of the latest arrangements for loading at the breech; (a complete description of this gun is to be found in *Appleton's Mechanics' Magazine* for March); it has sustained the effect of protracted firing without injury; the arrangement is objectionable in several respects, but a fatal one is, that if the needle fails to ignite the priming, the cartridge must be withdrawn. Jennings' repeating rifle also loads at the breech, and is probably one of the best of this order of rifles.

The cartridges of these two rifles are arranged upon precisely opposite principles. In the needle gun, the powder adjacent to the ball is first ignited; consequently, the ball when once in motion, is driven forward by a force less than that due to the greatest tension of the gas; for this force is evidently greater at the breech, where the combustion of the grains and evolution of gas is still going on, than at the place of the ball some distance off. In the Jennings rifle, the charge is ignited at the bottom; the loaded hollow ball carries the powder within it, and as the grains are successively consumed, the greatest tension and elastic force is exerted upon the ball at the instant and at the point where the last grain is consumed; a very small charge, therefore, produces a maximum effect.

Loading at the muzzle. This method takes more time than the preceding, fatigues the loader more, and increases the wear of the barrel to such an extent, particularly near the muzzle, that it is doubtful whether the greater simplicity of construction compensates for its inferior rapidity and difficulty of manipulation, and after some service, its diminished accuracy. Numerous methods of loading have been proposed to diminish these disadvantages.

1st, Loading with the aid of the mallet. This method is very objectionable, except for short distances as in pistol galleries, where this mode is usually adopted; any mode of forcing the ball which deforms it, as hard ramming or driving with the mallet, is injurious to the range, but favorable to accuracy, as it is susceptible of demonstration that the shortest axis is the axis of the greatest moment of inertia around which the motion of rotation is the most stable.

2d, With a greased patch. This method has almost entirely superseded all others; at the same time that the patch destroys the windage, it cleans the barrel for the next round. It is not, however, without serious objections; if the ball fits tightly, it is difficult to enter and force home with the ramrod; if the ball enters easily, it must be forcibly rammed, when home, to spread it into the grooves; an operation at once fatiguing to the loader,

and injurious to the shape of the ball. To assist in loading, there is furnished with the best American target rifles a *straight starter*, and a false or loading muzzle, which enters the conical ball fairly.

3d, The belted ball. The English military rifle has but two grooves; the ball, cast with a belt upon it, is enveloped in a greased patch, and the loading is performed with but little greater difficulty than with the musket; this is a very rude weapon, and except at very short ranges, has little accuracy or force; it is not astonishing that a people using a weapon which, compared with a Wesson's American rifle, stands in about the same relation to it that the bow and arrows do to a musket, should consider the authenticated performances of the latter as fabulous.

4th, The elliptical ball fired from a helical elliptically bored barrel. This idea, which has lately been reproduced in England under the name of Lancaster's elliptical *rifle*, dates from 1795; the practice with, has demonstrated that it is, independent of the difficulty of construction, inferior to all the modern rifles.

5th, The *carabine à tige*, or French pillar breeched rifle. This has also been imitated in Lancaster's pillar breeched rifle, and Wilkinson's stadia rifle. In this rifle, a steel pin, or pillar, about half the diameter of the bore, and three inches in length, is screwed into the centre of the breech pin; the powder fills the space around this pillar, and the ball is arrested by the end which is a plane; moderate ramming with the rod, spreads the ball into the grooves without crushing the grains of powder, or seriously deforming the ball; it was for this rifle that the grooved cylindro-conoidal ball was invented, which has reached a range and degree of accuracy hitherto unequalled.

6th, The Minié mode of loading. The accumulated dirt in long continued firing, and the difficulty of cleaning the breech, caused serious objections to be raised to the preceding mode of loading. Mr. Minié, therefore, proposed to hollow the base of the conical ball, and enter in it the point of a conical iron cup, or plug, which should be driven into the cavity by the force of the charge, expand the ball into the grooves, and thus force the ball without effort on the part of the loader. The loading is as rapid and simple as with the musket, and no alteration is required in the rifle; the ball alone is of different construction. The numerous and severe tests to which it has been submitted in Europe, would appear to be perfectly satisfactory, and it has been adopted by several nations. Still, it is open to objection; one of which is, that if the cartridge is damaged by exposure, the expansion may be either irregular or inefficient, and all accuracy lost. A small quantity of fulminating powder inserted in the cavity, would also produce the required effect, but the union of fulminating powder with the cartridge is highly objectionable, either in magazines, or during transportation from place to place. The great advantages of this discovery may lead to the adoption of the rifle as the sole weapon of the infantry soldier.

The Charge of Powder.—The charge of powder is only to be obtained by experiment; it should be sufficient, but not excessive. We must, therefore, consider, 1st, the quantity of powder which can be burnt while the ball is passing along the barrel: 2d, the required range, force, and accuracy: 3d, the recoil. Experiment proves that heavy charges pro-

duce great irregularities, and that the accuracy increases with the diminution of the charges; hence, the smallest charge capable of producing the required effect, is to be preferred. The recoil being directly proportional to the charge, it is evidently favorable to accuracy to employ small charges, by which we also diminish the inconveniences of fouling.

The Diameter and Shape of the Ball.—When the rifle loads at the breech, the ball should be of slightly greater diameter than the barrel, that the ball may be *forced* (caused to fill the grooves) by the action of the charge; if loaded at the muzzle, the ball must be somewhat smaller, or it will be deformed by the blow of the mallet, or other means adopted to enter it; it must also be of such diameter that the fouling of the bore will not prevent it from being rammed home; at the same time the windage must be sufficiently small to permit the spreading of the ball to fill the grooves without excessive ramming, which fatigues the loader and deforms the ball.

Hitherto, the spherical ball has generally been used, but it has been proposed to substitute a conical, cylindro-conical, or cylindro-conoidal ball; the first attempts were not successful; the ball was found to be deficient in stability, and abandoned.

When a spherical ball is fired with great velocity, the air in front is partly displaced, partly condensed, and driven before it, the particles forming a sort of conoid, having a base equal to the diameter of the ball, and a height dependent upon the velocity. If, then, the anterior surface of the ball is made the shape of this conoid, the escape of the condensed air will be facilitated, and the resistance due to its elasticity reduced to a simple friction. But since the axis of the conoid passing through its apex is that of the least moment of inertia, the conoidal ball is more affected by causes of deviation than the spherical ball; to overcome these defects, it becomes necessary to increase the rapidity of rotation; and since the elongated ball offers a great surface to the action of the grooves, there is no difficulty in combining a rapid rotation with considerable velocity. This developed a new deviation peculiar to the rifle, due to the parallelism of the axis of rotation. This deviation, which was named by the discoverer *derivation*, was observed to be always to the right or the left of the object, according as the turns of the spiral were from left to right, or right to left; and, increasing with the rapidity of rotation and the distance, can only be due to the rotation itself.

If we fire an elongated ball at a distant object, the axis of the rifle must be aimed sufficiently above it to compensate for the effect of gravity; the axis of the ball on issuing from the muzzle, takes the direction of the line of flight, the resistance of the air is concentrated upon the apex, consequently, the friction caused by the rotation is distributed equally around the ball, and there will be no deviation; but as the ball approaches the target, the axis, preserving its parallelism, makes an angle with the path of the ball, the anterior surface experiences greater pressure from the condensed air in front, while the posterior surface is in a vacuum, and there will be an unequal friction, which will impel the ball towards the right or left, depending on the direction of rotation. At 900 yards, with a cylindro-conoidal ball, the derivation amounted to four yards.

A careful study of these effects led to a discovery of the causes pro-

ducing and the means of correcting them, and subsequent experiment arranged the details of the *grooved* cylindro-conoidal ball, which in the *carabine à tige* and Minié rifle, has proved so efficacious.

The theory of this ball is easily explained. The centre of gravity of the ball being in the line of flight, and the axis making an angle with that line, any resistances in the rear of the centre of gravity must have a tendency to cause the ball to turn on that point, and make the axis of the ball coincide with the line of flight. This resistance was produced in the model ball by forming on the cylindrical part several circular grooves of a triangular section, the rear face perpendicular to the axis of the ball. Experiment fully confirms what theory designated as the remedy. The axis of the ball is constantly directed in the line of flight, the *derivation* disappears, the ball experiences the least possible resistance, and retains an almost incredible degree of force and accuracy at distances beyond the limits of distinct vision.

The Length of Barrel.—The charge should be such that its inflammation may be completed before the ball has left the gun; but as the charge is fixed in advance at the least quantity to produce the required effect, it follows that the barrel should be shortened to that point. An excessive length can but increase the friction and diminish the range, while experiment shows that it injuriously affects the accuracy.

The Inclination or Twist of the Grooves.—To determine this, we must examine the relations existing between the charge of powder and the inclination. It is evident that with equal charges, the rapidity of rotation increases with the inclination; it would therefore appear to follow that the accuracy should correspondingly increase; but as the rotation is produced by the friction of the ball in the grooves, if the charge is great and the twist quick, the small portions of lead entering these grooves are not capable of offering sufficient resistance to rupture, the ball will not follow the direction of the grooves, it must be cut or stript, and issue from the barrel greatly deformed, and totally devoid of accuracy. On the other hand, if the inclination is too small, the rotation will not be sufficiently rapid to overcome the several causes of deviation; it follows that we must increase the length of the spiral as we increase the charge.

The experiments to determine this point were made upon two natures of twist; the uniform, and the parabolic or increasing twist. In conformity with the laws of the motion of bodies, we should progressively increase the inclination of the grooves to the axis; for the ball being subjected at the same time to two motions, necessarily has a tendency to escape from the grooves; and the greater the inclination, the more difficult it will be to overcome this tendency; therefore, there should be some ratio established between the velocities of the motions of rotation and of progression. The experiments proved that for a quick twist of a turn in three to six feet, the increasing twist was preferable; but that for a spherical ball of musket calibre, a twist of about one-seventh, or a turn in twenty feet, was sufficient, and that for this length of twist the increasing twist had no advantages. The conical ball rotating on the axis of the least moment of inertia, requires a more rapid rotation to insure the stability of this axis; furthermore, the effect of the deviating force increasing with the diminution of the bore, it follows that the smaller the diameter of the ball, and the

greater its length in proportion to its diameter, the more rapid should be the twist. Rifles have been made in this country with a twist ending with a turn in eighteen inches; if this excessive twist was necessary to insure the stability of the ball, there were defects in the rifle, and the shape of the ball, which should have been remedied. Experiment shows, that with the same charge and more than a necessary degree of twist, there is a loss of range, accuracy, and killing force, at long distances; this is conformable to theory, for the friction and loss of force evidently increases with the twist.

Experiments were also made upon the *decreasing twist.* This idea has lately been reproduced and advocated by Greener in his treatise on the gun; these experiments proved that this was decidedly the least advantageous of all the methods proposed. The projectors of this arrangement argued, with some plausibility, that the velocity of rotation, (that is, the number of turns in a second of time,) was not due to the inclination of the grooves alone, but also to the velocity of the ball; and as this velocity was constantly increasing until the ball reached the muzzle, the inclination should decrease, that the ratio of the velocities should remain constant.

The Number of Grooves.—It has been shown, that diminishing the twist, to a certain limit, was attended with increased range and accuracy. Similar results attended a reduction of the number of grooves. At least two grooves are necessary; a single one would cause deviations from the instant the ball left the barrel. The number should be such that but moderate ramming is required to spread the ball into the grooves; for if the number is small, the depth must be correspondingly increased, to give sufficient hold to prevent the ball from stripping. If the number of grooves is an even number, the ball must be enlarged by ramming in the direction of a diameter by twice the depth of the groove; if the number is odd, the solid opposed to the crease assists in spreading the ball into the grooves. For these reasons an odd number is to be preferred; from five to seven is the preferable number. The *carabine à tige* has four, the Minié rifle five; some rifles have upwards of a hundred.

Depth of the Grooves.—The depth should be such that a moderate force will cause the lead to entirely fill the groove; otherwise a portion of the inflamed powder will escape through the grooves, injuriously affect the range and accuracy, and injure the barrel. If the grooves are very deep, the projections raised upon the ball will diminish its velocity and accuracy; consequently, too great a depth cannot be otherwise than injurious. Experiment must determine for the particular calibre and charge the least depth necessary; arms loading at the breech require a greater depth than those loading at the muzzle. The grooves should be of equal depth, *at the same distance* from the muzzle, or the unequal projections raised on the surface of the ball may cause great irregularities. Recent experiments have, however, shewn that it is highly advantageous to diminish the depth of the grooves *as they approach* the muzzle, and even that no injury is produced if a few inches near the muzzle are left smooth; this arrangement keeps the ball constantly fixed solidly in the groove, while the friction against the *lands* (or solids between the grooves) is scarcely sensible; the ridges raised on the ball by ramming almost entirely

disappear. In the American target rifle, particularly those of Wesson's make, the same object is sought to be attained (the solidity of the ball) by freeing the bore from the muzzle towards the breech; this method is attended with increased friction, on account of the greater surface of lands than of grooves, and has also the disadvantage of increasing the ridges raised by ramming.

The Shape of the Grooves.—A great many trials were made of grooves of different cross section. Of all the forms tried, the rectangular, with the interior angles rounded off, proved superior; for since neither the lead nor the patch can be forced into the angles of other grooves, they permit an escape of gas injurious to range and accuracy. It was also found preferable to have greater width of lands than of grooves; and that for the number adopted, three-eighths of the total circumference was sufficient.

The Thickness of the Barrel, and Material of which it is composed.—It is a firmly rooted popular opinion, that the barrels of rifles must be very thick, and the weapon heavy and unwieldy, to fire with accuracy; but repeated experiments have proved that a diminution of thickness and of weight had no injurious effect upon the accuracy, except so far as it increased the recoil, with charges much greater than any proposed for service. The musket barrel rifled gave results equal to the rifle of equal diameter of ball, weighing two pounds heavier. The homogeneity of the material composing the barrel is of much greater importance; a want of this quality causes an irregular vibration and a curvature of the barrel from unequal expansion. To insure a greater degree of it, the barrels of rifles, formerly made of iron, are now universally manufactured from cast steel. In addition to greater strength and homogeneousness, its hardness preserves the muzzle from wear, a matter of very great importance; for any aperture which may permit the gas to escape before the ball leaves the muzzle, must cause an initial deviation variable in amount, therefore not to be counteracted. For this reason, the best American target rifles are furnished with a false or loading muzzle, and the conical ball is entered with a straight starter, which preserves its axis perpendicular to the plane of the muzzle.

Vibration of the Barrel.—It is generally supposed, that by firing several successive shots from a rifle always charged and pointed alike, at a target placed at a short distance, the balls could not deviate in any direction, and therefore should pass through the same hole; but this is not the case. Upon firing several shots, from different barrels, through a piece of pasteboard placed six feet from the muzzle, it was observed that after a certain number of rounds, a circular opening was formed nearly double the diameter of the ball, the centre of which coincided with the axis of the bore. It was also proved that like results followed the use of the rifle and the musket, and that the deviations were in all directions. These results can only be attributed to the vibrations of the barrel.

These vibrations are of two sorts; the one perpendicular to the axis occasions a momentary swelling; the other, longitudinal, displaces the axis itself by an oscillatory movement; this longitudinal vibration, which is the most important, increases with the charge and the checks to a free recoil; the barrel recoiling freely, the vibration is scarcely sensible. It is also proved that recoil commences before the ball leaves the barrel.

The deviations being similar near the muzzle for all the barrels, rifled or smooth bore, good or bad, it is evident that the deviations at great distances can only be attributed to the resistance of the air; another proof that the principle of the rifle is necessary to diminish the effect of this resistance, but cannot cause the deviations to entirely disappear; also, that the figure and weight of the ball are of much greater consequence than is generally supposed.

A careful study of the facts brought together in the preceding pages, has led the writer to the following conclusions:

That the American rifle made by the best makers is a nearly perfect weapon, principally faulty in the smallness of the bore and too great length and weight of the barrel. But while the weapon itself so nearly fulfils the theoretical and mechanical conditions necessary for a successful practice, the manipulation and accessaries are decidedly faulty. The loading is difficult, tedious, and requires much practice and expertness; the balls are generally very acute conoids, with plane or hemispherical bases, the most susceptible of all forms to deviations; the rifle is in practice greatly overcharged, endeavoring to obtain by great velocity of ball a force and accuracy better obtained with a better form and greater weight. The heavy charge requires great strength of barrel, and consequently thickness and weight, to withstand its force, gives considerable recoil, and makes it necessary to clean the gun after a few rounds.

Practice with a rifle in the possession of the writer, made by Wesson, (admitted to be the best of makers,) of a calibre of forty-five spherical balls to the pound, proves these conclusions to be correct. The barrel, freed from near the muzzle towards the breech, was thirty-four inches long, rifled with an increasing twist, ending with a turn in six feet. The ball is purely conoidal; consequently, unless it is entered with the utmost nicety, the axis does not coincide with the axis of the bore; the charge was so great, that unless the ball was hardened with tin, it was frequently upset by the force of explosion.

The charge was subsequently reduced one-half; the ball increased in length to two diameters, three-eighths cylindrical, the other portion conoidal, the tangents to the curve at the apex forming an angle of about 70°; three grooves were formed upon the cylindrical part of the ball; the barrel was shortened to thirty inches. These alterations have been attended with the expected success. At the distance of forty to sixty rods, there is no perceptible advantage; but on increasing the distance, the superiority becomes more marked, till at 150 rods the accuracy is nearly doubled.

To obtain satisfactory results, so many precautions are necessary, so much practice required, and so long a time required to load the rifle, that it is not probable that such a weapon will ever be used for any other purpose than target practice, and some more convenient weapon must come into use.

The principle of loading at the breech, although liable to objections, must be admitted to be very advantageous, and can scarcely fail to be adopted for sporting purposes, arming of volunteer troops, and even a portion of the regular forces. Although the rifle so constructed is some-

what more difficult to manufacture, it is, by dispensing with the ramrod, more conveniently handled: if the mode of closing the breech is well arranged, the duration of the arm is at least equal to that of a rifle loading at the muzzle. The manual is more simple, easily learned, and the rifle may be loaded with facility even when lying down; the charge being small, the injuries due to its corrosive action are sensibly diminished: the recoil is scarcely perceptible, and the gun may be loaded an unlimited number of times without cleaning: for the same weight of gun, the bore may be larger, which has been shown to be advantageous.

A rifle on this principle, of a half inch bore, (32 to the pound,) properly constructed, firing a conoidal ball, with a charge of thirty grains of rifle powder, will be effective at half a mile, a distance beyond the limits of distinct vision, or our means of estimating distances with precision.

For the Journal of the Franklin Institute.

Railways and other Roads. By J. H. Fisher, Esq.

I propose to examine the question, whether the railway is the form of road which, so far as we now can see and judge, is the most economical and agreeable for populous districts.

Inventions are often the offspring of accidents, and always more or less modified by accidents. Roads, more than other inventions, have been subject to such modification, and turned from their normal growth by it; and until freed from it, they cannot attain to a condition that will satisfy the requirements of the various kinds of travel that must pass over them.

The motive power is the first accident that has modified roads. Without going back to semi-barbarous ages, in which none but rude vehicles existed, and roads were pathways of common earth, I will notice the modifications now adopted to accommodate them to animal power. Stone pavements are grooved, sometimes roughened over their entire surface, to give a firm foothold to horses; they are made of stones so small that they will form an uneven surface. All this roughness and unevenness of surface is injurious to the road as a street track, but necessary to enable the animals to obtain such a foothold as will resist the tendency to slip.

Railways, from their beginning until locomotives were introduced, were made for burdens so heavy that the common roads of the time could not bear them; and in order to draw such loads, it was necessary that the horse track should afford a secure foothold. The earliest were mere timber tracks for the wheels, with the common earth, or at best a gravel track, between them. As it was found that the timber would not without injury bear the pressure of the wheels, strips of iron were put upon them; and finally, iron rails upon cross sleepers of timber came into use, as the locomotive gradually developed itself.

It appears to me that the narrow wheel track, which could not have been kept except by slow moving vehicles, and the flanch rail or tram, were too obviously inconvenient to have been adopted, were it not for the necessity of a surface into which the horse could indent his toes, and

obtain a firm hold; and thus far at least the railroad seems to have derived its form from accident.

Let us now consider what might have been the form of the early colliery roads, had timber been cheap enough to make the whole surface of it, and had there been a varied and abundant traffic, requiring different rates of speed, turn-outs, stoppages, and all the impediments of roads in populous districts, and had the locomotive attained to the efficiency and cheapness of structure that characterize the light locomotives of the present day. The service required was to draw heavy loads at a rate so slow that a very simple steering apparatus would have sufficed. It was necessary, or at least desirable, that the colliery vehicles should pass each other; and other vehicles could not use the road unless allowed to pass freely by the burden vehicles. There can hardly be a doubt that the whole surface would have been timber; and a plank road, of the thickness and strength required for the service, would have been the result.

Or, if the locomotive had attained to this condition at the time when the lengthwise timber track was guarded from the crushing weight by a strip of iron, the question of a fulcrum for the motive power would have soon been settled, and an iron surface would have been adopted, unless the horse traffic were of such amount as to require a less slippery surface. As the case actually stood, there was an accident, which would have been less influential in the case we have supposed, but which had much to do with preserving the railway form. I allude to the strange notion that the adhesion of the wheels was insufficient to enable the locomotive to draw a load, or work upon a smooth surface more advantageously than horses could work. To overcome this imaginary difficulty, the toothed rail of Blenkinsop, and various imitations of horses' legs, were devised; all of them requiring that the rail should be preserved. This delusion might have been dispelled sooner, had the grades not been so steep that slipping would in some cases unavoidably occur if the loads drawn after the locomotive were of the usual weight that it could draw upon the lesser inclines.

These accidents, concurring perhaps with others, seem to have given rise to a system that could not have grown to its present magnitude had not the minds of the engineers, or mere workmen, been incapable of thoroughly investigating the subject before them. Step by step, the rail system advanced, from the timber track to the tram, from the tram to the rail for the flanch wheel, from the light and flimsy rail to the heavy and firm rail now in use. In the mean time the traffic increased, and demanded prompt and unremitting action, rather than deliberation. Inventors were required to determine how to time the trains, and avoid collisions and delays. This they accomplished by diminishing their number, and increasing to an enormous weight and size the cars and engines, so that instead of the three or four tons which a convenient passenger vehicle might have weighed, the passenger train now weighs a hundred tons or more.

While railways have been growing in this way, some efforts have been made to improve common roads; but they have been hindered, and until within a few years defeated, by the difficulties which lie in the way of level grading, and by the requirement of a surface upon which horses

can draw heavy loads without stopping. Cast iron pavements were tried in London twenty years ago, and abandoned because they were slippery. Stone tracks, composed of long dressed stones, with rough horse tracks between them, have been used where there is but moderate traffic. But in the main thoroughfares the improved wheel surface has been deemed an insufficient compensation for the danger of injuring horses, and stopping crowds of vehicles by their fall. A new trial of iron paving is now being made in Glasgow, thus far with such satisfactory results as make it probable that it will be generally adopted. The grooving is improved, so that the old difficulty of slipping is avoided; and the structure is cheaper, and promises to be more durable, than stone pavement. The cost is within two dollars per square yard; and if allowance be made for the exemption from the necessity of such repairs as are required by the wooden portion of railways, it appears that an iron pavement of sufficient width for turning out will not cost more than a double railway.

If we now suppose that horses are on the whole as expensive as steam power, in the present state of invention and workmanship, we may fairly assume that a road can be made of iron, with a surface and grade equal to the railway, which will accommodate every variety of traffic, and admit the use of vehicles that can diverge from it to reach the places where their burdens are to be set down and taken up. It is a fact well established, that no kind of road in ordinary condition is absolutely *impracticable* to steam carriages, however *unprofitable* it might be to run them upon bad roads alone.

Upon such a road there would be no necessity for mammoth trains, starting at long intervals, and stopping only at distant stations, requiring passengers to pay two coach fares in addition to the railway fare, in order to complete their journey. The loads would be light, and go without change of vehicle from their departure to their destination; passenger vehicles that must move rapidly, would be light, so that if they should run off the road, no damage could occur; and accommodation stages and private carriages could again come into use, and move as rapidly as the locomotive; and as they would avoid the delay of transhipment, they would perform their service with more despatch than the railway, at least upon short lines of travel.

Such a road could be sodded to the edge, and perfectly free from dust; and as it would be supported at all points upon a bed of concrete, and free from roughness, the wheels would run over it with very little noise or jolting. A smooth and quiet motion, with the privacy of one's own vehicle, and the comfort of having it well ventilated by the blowing-fan, and warmed by the waste steam, would render travel a luxury to be enjoyed, rather than a necessity to be endured, as it often is under the present system, especially in dry and dirty weather. And were street pavements made of iron, and horses not used, they would be free from dust and mud; and the expense of cleaning would be slight—the rain alone would keep them always cleaner than stone pavements can be kept by the usual process.

The expense of such a system should be estimated by a fair comparison of its utility with its cost to *all* who aid in paying for it. The cost of paving, street cleaning, road making, and much of the cost of clothing,

are fairly chargeable under the general head of cost of transit; but it has been too much the custom to look solely to the total expense of maintaining horses and their vehicles, and comparing it with the cost of other motive power, without reference to the comparative wear of the public roads, to the damage to private property and comfort by dust and mud, to the time lost in traveling, and to the wear of vehicles, and other expenses incidental to the form of road which we have assumed as the temporary and imperfect form. If the damage to clothing, comfort, and health, were much less, there would be a gain; not, however, to the coach proprietor, and he would not pay for it; if the time of travel were less, there would be a gain, but not to the public carrier; if street cleaning were lessened, there would be a gain, for which the coach proprietor might be willing to pay a part. But all these interests, and many others, will remain without the union that would produce reform, until the public constructs the roads, and distributes the taxes according to the benefits. If a road be made agreeable to the fastidious tastes of the wealthy, always perfectly clean, free from uncouth sights, and its sides beautifully ornamented with trees and shrubbery, it would be just that the pleasure carriages of that class should pay a tax somewhat proportioned to their value, and that the plain vehicle of the man in moderate circumstances should pay less. Part of the tax would be for embellishment—that part should be assessed chiefly upon those who would not willingly dispense with it; another part would be for wear of road, and that part should be assessed as a mileage tax, or, what might amount nearly to the same thing, each keeper of a carriage should pay a certain amount upon the renewal or repairs of his wheels.

But during the transition state, while horse power and elementary power are struggling for ascendency, roads will be of a mixed character. The general form of the train or track road will be more or less adopted. If iron be the material, the horse tracks will be grooved, and the wheel tracks smooth. But it will be found that habit and training will accustom horses to the smooth surface, so that, with light loads, they will not slip. The grooving will soon be dispensed with upon the level portions. In the mean time, every year will cheapen and improve machinery, until it will be no longer expedient to provide for the use of horses; and the roads will then be made of their normal form.

The present cost of steam power is a question of interest, which is more or less discussed, in England and this country. A select committee of the House of Commons, in 1831, after hearing the evidence of the proprietors of steam carriages, and numerous men of science, reported that steam carriages would become "a speedier and cheaper mode of conveyance than carriages drawn by horses." This prediction is by some thought to have failed; but what is the locomotive? it is a steam carriage, of huge size and proportion, running upon narrow tracks. This steam carriage has reduced the cost of traveling to a third, and increased the speed eightfold. Lighten it, give it a steering apparatus, run it upon a broad, flat surface, with railway grades, and you will not have impaired its efficacy; it is even now maintained in England, that two light locomotives to a train, are more efficient and economical than one heavy one: this, however, may be due to improvement in the plan or execution, or it may be a surreptitious puff. But if the prediction be not verified as to macadam

road carriages, it is because the iron road has proved the better and cheaper road, and with its steam carriage, has superseded almost every line of stage coaches in England.

I submit, then, that the steam carriage has not been beaten; it is the iron road that has beaten the stone road. What this or that inventor may have failed to do, is of little moment; but as the failure of Garry, Hancock, and others, is often quoted as a reason for doubting the power of steam to work upon common roads with economy, it is but just to say, that they were subjected to prohibitory tolls, which the House of Lords refused to regulate, after the Commons had passed a bill to regulate them; and that the same body refused to extend the patents, which had nearly expired before the inventions became efficient, and really got a little into use. It was not horse power that drove them from the macadam roads, but the power of the land interest, represented in the House of Lords, and in the turnpike trusts. The same interest opposed railways, from the same motive, the fear that the price of horse feed, and the rent of land, would not continue to rise.

Railways may for a long time occupy the long lines of travel, where there is little occasion for frequent stoppages; but in the vicinity of great cities, the iron road will be the more convenient, agreeable, and economical. It will admit the stout burden wagon, at a speed of eight or ten miles, which will not render it liable to run off the road; and it will allow free course to the light passenger carriage, at railway speed; and should it leave the iron track, as the locomotive sometimes does, its wheels will not cut into the ground, and it will easily regain the road without injury.

There is a vague notion that steam power is enormously heavy. The weight of the broad gauge locomotives, is 156 lbs. per horse power. The tender with its load may be one-fourth as much, or the total weight of the power and the vehicle to carry it, is within 200 lbs. per horse power, even in those engines which are made for long endurance, and with little regard to lightness. It may be reasonably estimated that a horse power would not exceed the weight of a passenger; and that a carriage which is strong enough to carry twelve passengers when drawn by two horses, would carry at least ten, if it had steam power attached to it. This basis is estimated upon what has been done; a careful estimate based upon the strength of materials, and the power obtainable from fuel and water, shows, that the motive power, apart from the vehicle that bears it, need not weigh more than fifty pounds per horse power.

The question of manageability has been settled by the experiments of the English; they can be managed with more ease and precision than horses. There is no smoke, noise, visible steam, or other nuisance attending them. And, although they employed two, and sometimes three men upon each carriage, there is no doubt that one man is capable of doing all that is required upon the roads. The fuel and water are supplied at the stations, and so disposed that they are fed into the furnace and boiler without any attention from the conductor; and a gentleman will find it by no means unpleasant to manage his own carriage, which he can do from within, without the least exposure to the weather.

I have inquired of machinists as to what it would cost to construct the machinery for a carriage for four or six persons, and I find it would be

about seven hundred dollars. The interest on this sum, and an allowance for wear of double the amount in locomotives, with the expense of fuel, oil, etc., and all other expenses, would not amount to so much as it costs to keep one horse and his vehicle. It is therefore probable that private carriages will come into extensive use as roads improve. And the sooner the main roads are improved, the sooner will this convenience be within the reach of all industrious and economical persons.

Observations on Artificial Hydraulic or Portland Cement; with an Account of the Testing of the Brick Beam erected at the Great Exhibition. By Mr. G. F. White, Assoc. C. E.*

After detailing the experiments made by the late Sir Isambard Brunel, the paper noticed the peculiarities in the practice of the English and foreign engineers in the use of cements and limes. It was stated, that in England, the natural cements were plentiful, and the mode of construction being generally in brickwork, quick setting cements were preferred; whereas, abroad, the natural cement stones were, comparatively speaking, rare, and the use of bricks rather the exception than the rule. In some cases it was found, that even the best natural hydraulic limes did not set with sufficient rapidity in salt water, to do away with the necessity for using pozzalanos; and some of the attempts made at various periods to substitute artificial pozzalanos for the very expensive natural products of that nature, were then described. The unfavorable results of these attempts, and the manner in which M. Vicat explained them, were detailed. A sketch was then given of the course of investigation followed in England by Mr. Frost, and General Sir Charles Pasley, from which it appeared that, until the introduction of the Portland cements, no artificial compound had been discovered, which possessed the same, or greater powers of resistance than those of the natural cements. The advantages of the Portland cement were stated to be that it had nearly all the qualities of rapid setting presented by the natural materials of the same class; and, in addition, that as it was capable of supporting variable proportions of sand, it could be used as a mortar, the rate of setting of which might be modified at will, and the powers of resistance of which were stated to be much greater than those of either the cements or the limes thus replaced.

A general description of the manner in which the Portland cement was now manufactured, and of the methods of testing the article, were then given; and it appeared, that, after seven days, the cohesive strength of the neat cement was equal to about 100 lbs. on the square inch; and that after six months, this became equal to not less than 414 lbs. per square inch. M. Vicat had stated, in 1851, in a communication to the *Annales des Ponts et Chaussees*, that by the use of Portland cement alone, or what he termed "overburnt lime," it would be possible to form immense artificial blocks, capable of resisting the action of the waves and of the shingle upon the sea shore; an action which it was well known rapidly destroyed the natural cements, and the pozzalanic mixtures, whether of natural or artificial pozzalanos.

* From the London Journal of Arts and Sciences, July, 1852.

The several applications of the Portland cement as a concrete, as a mortar, and as a stucco, were then alluded to, and reference was made to the early failures in forming large artificial blocks; and an account was given of the mode now adopted in constructing them at Dover and Alderney harbors of refuge, and likewise of those employed to protect the extremities of the breakwater of Cherbourg. At Dover, the hearting of the piers, below high-water mark, was executed in blocks of concrete, composed of cement and shingle in the proportions of 1 to 10, and occupying about three-fourths of the volume of the separate materials measured in the dry state. Each block contained from 30 cubic feet to 120 cubic feet, and weighed from 2 tons to 7 tons. At Alderney, a species of concrete, composed of cement, sand, and shingle, was placed in a mould, with rubble stone, bedded irregularly in the mass; the proportions being about one part of cement to ten parts of foreign materials. At Cherbourg, the system adopted was to build immense blocks of rubble masonry of not less than 712 cubic feet, and weighing about 52 tons. These blocks were floated out from the places where they were constructed, and sunk as "pierre perdue;" but this had not on all occasions been able to resist the transporting power of the waves. The manner of using the cement was in the form of mortar, composed of one part of cement to three parts of sand.

It had been stated by M. Vicat, that the powers of resistance to compression absolutely required, in substances exposed to the action of the sea, must be at least equal to 40 lbs. per square inch, and of that to tension at least equal to 9 lbs. on the square inch. Now, the resistance of the artificial stone blocks, after an interval of nine months, was not less than 1700 lbs. per square inch, when the effort was one of compression, or than 200 lbs. per square inch, when it became an effort of tension, or little inferior to that of Portland stone itself.

Attention was called to the fact, that the Portland cement adhered more energetically to the Portland stone than to any other material. This degree of adhesion did not seem to depend so much upon the absorbent powers of the substances connected together by the cement, as upon some coincidence in the manner of their crystalization.

The applications of Portland cement to the purposes of stucco, for external works, were noticed. Its advantages were stated to consist in its agreeable color, without the intervention of paint or lime-white, its power of resisting frost, and its freedom from vegetation: all which were attributed to the close contact of its constituent parts, and to the surface being perfectly non-absorbent. For the same reason, it was asserted that the Portland cement was eminently adapted for the construction of cisterns and baths, and for the various descriptions of statues and fountains, &c., now made of artificial stone.

The paper concluded by a description of the experiments on the brick beam at the Great Exhibition of 1851: from which it was deduced that the strength of Portland cement, as compared with Roman cement, was in the ratio of $2\frac{1}{3}$th to 1. Attention was called to the several tables and diagrams, which were exhibited, illustrative of the various power of resistance of the cement under efforts of compression, extension, and tearing asunder.—*Proc. Inst. Mech. Engineers.*

AMERICAN PATENTS.

List of American Patents which issued from July 6th, to August 3d, 1852, (inclusive,) with Exemplifications by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improved Centre Square for Finding the Centre of a Circle;* Nathan Ames, Saugus, Assignor to Walter Bryent, Boston, Massachusetts, July 6.

Claim.—"What I claim as my invention is, 1st, The application to an instrument, substantially in the manner herein set forth, of a geometrical fact, viz: that any circle touching the sides of a right angle may be divided into two equal parts, by the line which divides the right angle into two equal parts.

"Secondly, the union of the above with the common "trying square," by means of the bar as described."

2. For an *Improvement in the Construction of Bridges;* Abel Bradway and Elijah Valentine, Monson, Massachusetts, July 6.

Claim.—"What we claim as our invention is, the combination of the string pieces with the posts, the cross joints, the saddles, the diagonal braces, and the ties of a bridge frame, in such manner that the said string pieces are enabled to move longitudinally under the influence of variations of temperature, or other cause, without injury to themselves, or to the parts with which they are combined, substantially as herein set forth."

3. For an *Improvement in Car Seats;* John Briggs, Boston, Massachusetts, July 5.

Claim.—"What I claim as my invention is, a car seat constructed with a double back, which can be folded up or unfolded, by means of the hinged arms, operating as above set forth; the two pieces which constitute the back being held together when open or raised up by the spring lips, substantially as above described."

4. For an *Improvement in Turning Engines;* James S. Brown, Pawtucket, Massachusetts, July 6.

Claim.—"What I claim is, the clasp, in combination with the slide and saddle, for the purpose of arresting the combined operation of the slide and the pattern when required.

"And I also claim the cylindrical nut, in combination with the standard and tool holder of the slide rest as described, by which the edge of the tool is brought to the proper position to co-operate with the pattern bar and slide rest, substantially as is herein set forth."

5. For an *Improvement in the Construction of Bridges;* J. B. Gridley, Brooklyn, New York, July 6.

Claim.—"I am aware that diagonal or inclined counter braces, differently arranged, have before been used; such, therefore, irrespective of their disposition and combination as specified, I do not claim; but what I do claim as my invention is, the upper and lower counter braces, inclining in reverse directions to one another, for either half of the span, as shown and described, and connecting the double diagonal main brace with the upper and lower chords united by tie timbers as specified, producing the important results herein set forth."

6. For an *Improvement in Hand Planes;* Birdsill Holly, Seneca Falls, New York, July 6.

"The nature of this invention consists, 1st, in certain improvements in the stock, and in the cap of the iron, which allow the width of the throat to be altered for different kinds of work.

"2d, In certain means, by which the cap of the iron is always caused to drop into its place without requiring any adjustment or setting."

Claim.—"What I claim as my invention is, 1st, the loop on the cap, in combination with the plane iron and the stem of the stock, in the manner substantially as described, to wit: the said loop fitting over or embracing the plane iron and stem, and allowing the iron to be secured between the cap and the stem, by means of a wedge, placed either between the back of the iron and front of the stem, between the front of the iron and the cap, or between the back side of the stem and back part of the loop, the three positions of the wedge forming three different widths of throat, as herein explained.

"2nd, Providing the cap with shoulders, which, when the cap is placed in the stock of

the plane, will fall on suitable resting pieces, provided in or upon the stock, substantially as described."

7. For an *Improvement in Patterns for Metal Hubs, &c.;* Jasper Johnson, Geneseo, New York, July 6.

Claim.—"Having described my improvement, what I claim as my invention is, furnishing the usual pattern with a shield, as herein described, whereby I am enabled more easily to draw the core and prevent chipping and breaking down thereof."

8. For an *Improvement in Portable Grain Mills;* Charles Leavitt, Quincy, Illinois, July 6.

Claim.—"What I claim as my invention is, forming the inner stationary cone with a cavity, (square or otherwise,) as described, for the purpose of readily securing the mill on the top of a post or stump, without the use of bolts or wedges, &c., as set forth."

9. For an *Improvement in Churns;* Norman B. Livingston, Portland, Indiana, July 6.

Claim.—"Having thus fully described the nature of my improvement in churns, what I claim therein as new is, the racks, grooves, and pinions, by which the shaft and beaters are caused to traverse the milk or cream, with a compound vertical revolving and reciprocating motion, after the manner and for the purposes described."

10. For an *Improvement in Railroad Car Brakes;* Wm. Montgomery, Roxbury, Massachusetts, July 6.

Claim.—"I do not claim the mere combination of the plates or surfaces, one of which shall be made to rub against the other and constitute a friction brake; but what I do claim as my invention is, my improved brake, composed of three or any greater number of plates or disks, arranged side by side and on a shaft, and having some one or more of them connected with the shaft, so as to be revolved by it, and the others held stationary, so as not to be revolved, and the whole, except one of the outer ones, made to slide endwise on the shaft, and combined with an apparatus or means of pressing them towards and against one another, substantially as specified.

"I also claim the combination of the cross rods, with their friction plates and axle, for the purpose of sustaining the axle in case of fracture of it, as specified."

11. For an *Improvement in Processes for Defecating Sugar;* Robert and John Oxland, England, July 6, 1852; patented in England, May 15, 1851.

"These improvements consist in the combining of acetate of alumina, aluminate of lime, and phosphoric acid, for defecating saccharine liquids, or solution of sugar, and for removing their color."

Claim.—"Having thus described the nature of our improvements, and the manner of performing the same, we would have it understood that we do not confine ourselves to the details as herein given, nor to the phosphates mentioned, as others may be substituted; what we claim is, the use of aluminate of lime, in combination with the super-phosphate of alumina, or of lime, or with the phosphoric acid, for clarifying cane juice or syrups, as set forth: but we disclaim the use of phosphoric acid, except in combination with the above named bases."

12. For an *Improvement in Cutter Heads for Planing;* James M. Patton and Wm. F. Fergus, Philadelphia, Pennsylvania, July 6.

Claim.—"What we claim as our invention is, our improved elliptical reducing and planing instrument, composed of obliquely acting cutters, secured to an elliptical plate in such a manner that the periphery of the said plate will gauge the depth of the action of the cutters, and also serve to hold down the material operated upon, substantially as herein set forth."

13. For an *Improvement in Cordage Machines;* John W. Peer, Schenectady, New York, July 6.

"The nature of my invention consists in the combination of the scrolls and pinions, with friction pulleys, thereby producing regular feed motion, with an uniformity and equality of strain on each strand of rope, whilst laying or forming."

Claim.—"Having thus described the construction and operation of my machine, what I claim is, the use of grooved scrolls, and their combination with pinions, and grooved rollers, and friction rollers, or equivalents for such friction rollers, to create a regular feed motion and equality of strain, whilst laying or forming, in a rope, twine, or cordage ma-

chine; the whole being constructed in the manner and for the purpose substantially the same as described."

14. For an *Improvement in Double Acting Doors;* William Rippon, Providence, Rhode Island, July 6.

Claim.—"What I claim as my invention is, the manner substantially as herein described of arranging vertical and horizontal adjustable slats along the front, top, and back edges of the door, for the purpose of allowing the door being opened in either direction, in or out; said slats being made to operate in the manner herein specified, by means of the door, levers, or their equivalents, and springs; the whole being constructed and arrranged in the manner herein set forth."

15. For an *Improved Mode of Grinding Puppet Valves while the Engine is in Motion;* Enos Rogers, City of New York, July 6.

"The nature of my invention consists in a combination of certain mechanical elements, so adjusted and applied to the valves of steam engines while in use, that the valves thereby are caused to rotate slowly upon their seats during the period of time that they remain shut."

Claim.—"What I claim as my invention is, the valve provided with spindles free to turn on their lifters, in combination with mechanical devices, substantially such as are herein described, which rotate said valves when down on their seats, but do not act on said valves when rising or falling; the whole acting substantially in the manner and for the purposes described."

16. For an *Improvement in Machines for Rubbing Stone;* Pleasant E. Royse, New Albany, Indiana, and Ira Reynolds, Republic, Ohio, July 6.

Claim.—"We are aware that stationary or fixed wheels have been placed in the centre of stone rubbing machines, with cranked pinions revolving on their own axis and around the said fixed wheels as a common centre; therefore, we do not wish, or intend to claim, the arrangement of stationary or fixed wheels, around which the pinions revolve, to give motion to the arms and rubbers; but what we do claim as our invention is, the arrangement of a revolving centre driving wheel, with a series of stationary crank shaft pinions revolving on their own axis, whether in combination with the cranks or stationary pins, so constructed and arranged upon a radial line, as to give the arms and rubbers a rotary or compound elliptic rotary motion, for the purposes herein shown and set forth."

17. For an *Improved Combination of Cutters for Threading Wood Screws;* Thomas J. Sloan, City of New York, July 6.

"The nature of my invention consists in combining the operation of forming the threads of wood screws, by means of the burr cutter, with the operation of finishing and smoothing the thread, by means of a chaser, the screw blanks being in succession shifted from the operation of the burr cutter, where the thread is cut and formed, to the chaser, where it is finished, thus combining the advantages of both systems."

Claim.—"I do not wish to limit myself to the mode of construction of the various parts, or their arrangement, as they may be varied to a great extent, without changing the principle or mode of operation of my invention; what I claim is, the method, substantially as herein specified, of cutting away the mass of the metal to form the thread, by means of a burr cuttter, in combination with the method, substantially as specified, of finishing and smoothing the thread, by means of the chaser, as set forth."

18. For an *Improvement in the Thermostat for Regulating Heat;* Thomas J. Sloan, City of New York, July 6.

Claim.—"What I claim as my invention is, the application of the physical principle of the expansion and contraction of substances by varying degrees of heat, to regulate and control a mechanism, applied to operate a damper, register, valve, ventilator, or other equivalent device, which mechanism is actuated or propelled by some independent motor, substantially in the manner and for the purpose specified."

19. For an *Improvement in Pneumatic Spring;* Elijah Ware, Roxbury, Massachusetts, July 6.

Claim.—"Having thus described my improvements, what I claim as my invention in an air car spring, in which the piston operates upon the disk of rubber or other elastic substance which forms one side of the air chamber, is, the combination of the movable diaphragm,

constructed of the pieces, operating substantially as herein above described, with the rings placed loosely on the same, for the purpose herein set forth."

20. For *Improvements in Planing Machines;* William Watson, Chicago, Illinois, July 6.

Claim.—"Having thus described my improvements, what I specifically claim therein as new is, a reducing plane, composed of a series of oblique irons, arranged substantially as herein set forth.

"I also claim the combination of the before claimed reducing cutters with smoothing cutters, arranged substantially as herein set forth."

21. For an *Improvement in Railroad Car Brakes;* Lafayette F. Thompson, Charlestown, and Asahel G. Bachelder, Lowell, Massachusetts, Assignors to Henry Tanner, Buffalo, New York, July 6.

Claim.—"What is claimed by us is, to so combine the brakes of the two trucks with the operative windlass or their equivalents, at both ends of the car, by means of the vibrating lever, or its equivalent, or mechanism essentially as specified, as to enable the brakeman, by operating either of the windlasses to simultaneously apply the brakes of both trucks, or bring or force them against their respective wheels, and whether he be at the forward or rear part of the car."

22. For an *Improved Screw Threading Machinery;* Cullen Whipple, Assignor to the New England Screw Company, Providence, Rhode Island, July 6, 1852; ante-dated May 15, 1852.

Claim.—"What I claim as my invention is, a fusee, threading cutter for threading screw blanks, substantially as herein set forth.

"I also claim the arrangement of the cutter and blank, in such manner that the adjacent portions of their peripheries shall move in opposite directions during the operation of threading, so that the metal may be cut from the grooves in the blank from the bottom outwards, to allow the chip to be freely discharged, substantially as herein set forth.

"I also claim the combination of the vibrating feeding trough and screw driver, arranged in such manner that when the driver is pushed forward to turn a blank, while being threaded, an unthreaded blank may lie in the trough upon the driver, ready to drop into place before it, the instant it is drawn back, to allow the previous blank to be withdrawn from the cutter.

"I also claim the combination of the vibrating arm, or its equivalent, to detach the head of a threading blank from the bit of the screw driver, with a discharging punch, or its equivalent, to eject the threaded blank from the rest, the two thus operating, insuring the discharge of one blank before another is presented.

"Lastly, I claim a spring, or the equivalent thereof, in the mandrel of the screw driver, substantially as herein set forth, to impart to the bit of the screw driver, a slight yielding pressure against the head of the blank, until it winds and enters the nick thereof, in combination with the lever and cam, which afterwards apply to the driver a positive motion to keep it engaged with the blank while the latter is turned to be threaded, substantially as described."

23. For *Improvements in Machines for Tonguing Boards;* Samuel Albro, (late) Buffalo, New York, July 13.

"The nature of my invention consists in the making of a flaring stock, for the free escape of the shavings, and in combination therewith a series of cutters, so arranged as to cut a shaving both from the side and shoulder of the rebate, and giving to the said cutters a double grade, so as to be adjustable both to the side and shoulder aforesaid."

Claim.—"Having thus fully described my invention in tonguing, what I claim therein as new is, in combination with a flaring stock, substantially as described, the arranging of a series of cutters therein, so formed as to take the shavings from the sides and shoulders of the rebate, substantially as described; and this I claim, whether said cutters have a double or single graduation, so that I attain the result herein set forth, by substantially the arrangement and combination herein described."

24. For an *Improved Instrument for Driving Nails in Difficult Places;* Seth P. Carpenter, Milford, Massachusetts, July 13.

Claim.—"What I claim as my invention is, the instrument as constructed, of a combination of a tube, two or more springs, one or more holding points, and ramrod, and made to operate substantially as herein before specified."

25. For an *Improvement in Cast Iron Caissons;* James P. Duffey, Philadelphia, Pennsylvania, July 13.

Claim.—"Having thus described my invention, what I claim as new is, the method of bracing rectangular or other shaped metallic boxes, by means of the diagonal braces and rods, the braces and rods being arranged in the manner substantially as set forth."

26. For an *Improvement in Threshing Machines;* Joseph G. Gilbert, City of New York, July 13.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described of constructing skeleton threshing cylinders, viz: by bolting or welding to the arms, which are attached to the shaft, any suitable number of branches, which, together with the arms, present their edges to the line of motion, and are provided with serrated ends, substantially in the manner and for the purpose set forth."

27. For an *Improvement in Shingle Machines;* Furman Hand, Jr., Chicago, Illinois, July 13.

Claim.—"Having thus fully described my invention, what I claim as new is, so combining and arranging the riving knife and the shaving knives in their ways, as that, after the shingle has been separated, or nearly so, from the bolt, it will be carried forward by the carriage to the shaving knives, where it is finished, and so that the riving knife shall remain stationary, until the shaving knives have taken firm hold of the rived shingle; the whole being operated by the means substantially as herein described.

"I also claim, in combination, the double carriage, one moving on the top or over the other, and so arranged that one shall feed up the riven shingle to the knives, and the other shall carry back the bolt, at each operation of the machine, sufficiently far to cut off one shingle therefrom; the whole being operated substantially in the manner described."

28. For an *Improvement in Railroad Car Brakes;* Joseph P. Martin, Philadelphia, Pennsylvania, July 13.

"The nature of this invention consists in operating on the upper ends of the levers which move the rubbers of railroad car brakes, by longitudinal jointed bars, moving in guides at the will of the engineer, when the train is in forward motion, and projecting beyond either end of the car; the inner one of said bars being held in a suspended state, by means of a chain passing over a roller above the same, and around the shaft of the friction wheels, resting on the shaft of the wheels of the car, in such a manner as to enable the inner end of said inner bar to descend and clear itself of contact with the rubber levers, after the train has been checked, in order to back the same, and to be raised to its former position for acting, after the train has been moved a certain distance ahead."

Claim.—"What I claim as new is, the method of raising the forked or cam hook end of the jointed bar to a horizontal position, immediately in advance of the pin, at the upper end of the rubber levers, so that it will act upon the same when forced back, and enabling it to detach itself and descend to an inclined position, when it is desired to back the train, by means of the friction wheels, whose shaft moves in slots, and whose peripheries rest on the car wheel shaft or axle and chain, attached to the shaft of the friction wheels, and passing over the roller above the jointed bar, to which it is attached, arranged and operated as herein described, whether the said jointed bar be attached to the sliding bar represented, or to the ordinary bumper of the car."

29. For an *Improvement in Churns;* John McLaughlin, Goshen, Ohio, July 13.

Claim.—"I am aware that oscillating churns have been used before; therefore this I do not claim: but what I do claim as my improvement is, mounting the churn tub or barrel, composed of two sections, and containing a grate at their junction, within a clasp band, united to pivoted pendent bars, whereby, through means of a lever, the barrel is so operated as to present its ends uppermost, the one after the other, by which the milk or cream is carried up by one section, and allowed to descend through the grate, as described."

30. For an *Improvement in Shingle Machines;* Robert L. Noblet, Haverford, Pennsylvania, July 13.

Claim.—"Having thus fully described my invention, what I claim therein as new is, making the double racks in segments, one of which is stationary, and the other adjustable, for the purpose of cutting shingles of various thicknesses at butt and point, with the same racks, substantially as described."

31. For an *Improvement in Benzole Lights;* Henry M. Paine, Worcester, Massachusetts, July 13.

Claim.—"I do not lay claim to any particular apparatus; but what I do claim as my invention or discovery is, the mixture of alcohol, benzole, and water, with such proportions of water as shall render the liquid milky in appearance, and passing air through the same, substantially as herein set forth. I do not confine myself to the exact proportion of water named in the specification, but to cover the results herein named."

32. For an *Improvement in Corn Shellers;* William Reading, Washington, District of Columbia, July 13.

Claim.—"Having thus fully described my improved corn sheller, what I claim therein as new is, the within described combination of a toothed or flanched cylinder, with an enclosing cylindrical casing, of such proportions respectively, and so arranged, the one within the other, as to leave an amount of space between the two which shall cause the cobs and ears to clog and accumulate therein, during their passage through the same, and form an elastic self-adjusting bed, for the spirally arranged teeth or flanches of the shelling cylinder to act in concert with, in place of the stationary bar or rest, which is employed in all other cylindrical corn shellers."

33. For an *Improvement in Cast Iron Car Wheels;* Hiram H. Scoville, Chicago, Illinois, July 13.

Claim.—"Having thus described my improved car wheels, what I claim as new therein is, the double curved arms interlacing one another, and uniting the opposite edges of the rim and hub, substantially as specified."

34. For an *Improvement in Bedstead Fastenings;* Isaac A. Sergeant, Hamilton, Ohio, July 13.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, forming the tenon portion of a bedstead joint by catch-studs or pins, having heads projecting rectangularly from tangs, so tapered and notched, that by being slipped forcibly past each other, they can be made to interlock within a socket, drilled for them, across the radial or bastard grain of the rail tenon, and be made, by their thus interlocking, to resist any tendency to be drawn out from the rail, and by the compressure of their heads, to prevent the rending apart of the fibre of the tenon, and can be made of such dimensions that a pin of adequate strength can be inserted within the limits of an ordinary bedstead tenon."

35. For an *Improvement in Alarm Clocks;* Jonathan S. Turner, New Haven, Connecticut, July 13.

"My improvement consists in so constructing the alarm part, that it will give alarms for eight days (or more) with once winding, and so that it will give but one alarm in twenty-four hours, or while the hour hand is making two complete revolutions."

Claim.—"What I claim as my invention is, the combination of the double notched cam, with the locking apparatus, with their appendages, and giving more than one alarm with once winding, when the whole is constructed, arranged, and combined, substantially as herein described."

36. For an *Improvement in Cotton Presses;* Jacob G. Winger, Vicksburgh, Mississippi, July 13.

"The nature of my invention consists in constructing a press with two right hand and one left hand screws, or two left hand and one right, as herein after described, so as to give three times the progressive motion to the follower, in the same time, that would be effected by a single screw; and so arranging it, that the entire weight of the frame and chamber of the press is made effective to aid in pressing the bale."

Claim.—"Having thus described my invention, what I claim therein as new is, the arrangement and combination of the screws with the top and bottom cross beams of the frame, and the cross head of the follower, by which the follower and bed plate are made to press the bale from top and bottom, and the distance traveled by the follower towards the bed plate is three times that of the frame (to which the power is applied) over the screw.

2d, I claim making the weight of the press an auxiliary power, by resting it entirely on the lower screw, so that in pressing the bale, the frame is traveling down the screw, as on an inclined plane."

37. For an *Improvement in Seed Planters;* Joshua Woodward, Haverhill, New Hampshire, July 13.

Claim.—"Having thus fully described my improved seeding apparatus, and the various modes I contemplate modifying it, as required by law, what I claim therein as new is, the hooked rod, constructed and arranged substantially in the manner and for the purpose set forth."

38. For an *Improvement in Door Locks;* Marcus R. Stephenson, Assignor to Edwin Holman, Boston, Massachusetts, July 13.

Claim.—"I claim the combination of the cover plate and its arbor, with the slide for carrying the bitt plate, and a contrivance applied to the said arbor, and made to actuate the said slide and bitt plate, all constructed and made to operate together substantially as herein before described.

"And I also claim the improvement termed the circular arc lip, in its combination with the cover plate, and made to project down between the bitt plate recess and the tumblers, when the bitt plate hole or entrance of the cover plate uncovers the bitt plate recess, either in whole or in part, all substantially as herein before explained."

39. For an *Improvement in Fire Engines;* Orville G. Adkins, Oswego, New York, July 20.

Claim.—"What I claim as my invention is, the mode herein described, of drawing the resistance towards the fulcrum of the lever to which the power is applied through its entire descent; thereby lengthening the long arm, and shortening the short arm of the lever, substantially as described."

40. For an *Improvement in Car Seats;* William S. Bass, Cambridge, Massachusetts, July 20.

"The object of my improvements is, to secure an easy and comfortable car seat, so constructed as to admit of a person's reclining as far back as is desirable, while at the same time it will occupy no more room than those which have heretofore been in common use."

Claim.—"Having thus described my improvements, what I claim as my invention is, a car seat, to the bottom of which are jointed a back and leg support; the said back and leg support being placed and held at any desired angle, by arms fastened to the side arms in any desirable way, as above set forth."

41. For an *Improvement in Ploughs;* Neri Blatchly, Windsor, New York, July 20.

Claim.—"What I claim as my invention is, the arrangement of the beam of a plough with respect to the irons, and the bending of the standard towards the land, and having its line of direction parallel with that of the land side, in the manner and for the purposes herein set forth."

42. For *Improvements in Machines for Shaving Shingles;* Abel Bradway, Monson, Massachusetts, July 20.

Claim.—"Having thus fully described my improved machine for dressing riven shingles, what I claim therein as new is, the combination and arrangement of the yielding knives, the sliding shingle patterns, the roller, the elastic bed, the plate, and box, substantially in the manner and for the purpose as herein set forth."

43. For an *Improvement in Method of Converting Reciprocating Rotary into Reciprocating Rectilinear Motion;* Alfred Carson, City of New York, July 20.

Claim.—"I do not claim the use of pulleys, chains, and guides, for the purpose of converting rotary reciprocating into rectiliner reciprocating motion; but what I do claim as my invention is, slotting or forking the rods, and letting their two sides into grooves in the periphery of the pulley, and connecting the rods and pulley by three chains, two of which connect with each rod on opposite sides, and pass in one direction around the pulley, and the other connects with each rod within the slot or fork, and passes in the opposite direction round the pulley, for the purpose of guiding and directing the rods, and dispensing with the ways and cross heads ordinarily made use of for this purpose; the several parts operating substantially as and for the purpose set forth."

44. For an *Improvement in Machines for Dressing Stone;* Robert Eastman, Concord, New Hampshire, Assignor to Capt. Seth Eastman, Washington, District of Columbia, July 20.

"The nature of my invention consists in dressing or working the stone or other material

by forcing the chisels, picks, or cutters against it, by a positive crank motion, so that they cut with a steady positive motion, under the combined action of the crank, instead of cutting with a blow."

Claim.—"What I claim as new in the within described machine for dressing stone, and for facing, reeding, fluting, and cutting mouldings upon stone, is the operating of one or more chisels or tools, by a crank or cranks, or their equivalents, which, by their continued action upon said tools, thrust or force them against the stone or other material to be worked, substantially as described."

45. For an *Improvement in Cruppers for Harness;* John J. Flack, Joliet, Illinois, July 20.

Claim.—"What I claim as my invention is, the construction of a crupper, as herein described, by means of which, in taming or subduing horses, the tail of the horse may be kept in a desired position, without the necessity of resorting to the painful and injurious operation of nicking or pricking, and the pulleys, and to be used for the same purpose, when riding or driving the horse."

46. For an *Improvement in Grain and Grass Harvesters;* Eliakim B. Forbush, Buffalo, New York, July 20.

Claim.—"I claim as my invention, 1st, an open spaced guard finger with an inside surface, or middle finger, for the cutting tooth to cut against, substantially as herein described.

"2d, I claim the construction of a clamp of two parts, which will hold the finger bar, where desired, without bolts passing through the finger bar, arranged as herein set forth.

"3d, I claim the construction of a mould board with two upright posts, which posts pass through proper apertures in the frame of the machine, and are free to move up or down, according to the varying surface of the ground, and sustain the mould board forward of the cutter bar, on an angle sufficient to move the mown grass which may be forward of the finger bar to the inside of the clamp, substantially as herein described.

"4th, I claim the arrangement and combination of a right angled stanchion, made of wood or metal, with a pivotal motion on the frame work of the machine, and supporting upon its upright part a crooked lever made of wood or metal, with a pivotal motion on the said stanchion, to which lever is attached a rake; by the combination and operation of these two pivotal motions of the stanchion and lever, as set forth, a direct line motion may be given to the rake where needed, as also a circular motion, so that a person may remove the grain from the platform in bundles, and sit or stand on the machine near the driving wheel, as herein described."

47. For an *Improvement in Railroad Car Brakes;* Wm. Hall, North Adams, Massachusetts, July 20.

Claim.—"What I claim as of my invention is, the combination of the sliding detached lever with the main lever and the connecting rods, so as to operate essentially in the manner and for the purpose as herein before specified."

48. For an *Improvement in Rice Hullers;* Clark Jacobs, Brooklyn, New York, July 20.

Claim.—"I do not claim the use of india rubber surfaces for hulling the rice, such having been used before; but what I do claim as my invention is, the use of a vulcanized gum elastic, or rubber, or its equivalent, in combination with a stone or other equivalent non-elastic rubbing surface, for hulling rice, substantially in the manner herein set forth.

"I also claim the manner of constructing the rubber of three substances of different qualities, viz: the metallic disk, leather disk, and gum elastic, or gutta percha disk, by which firmness, elasticity, and durability are combined, substantially as herein described."

49. For an *Improvement in Grass Harvesters;* Jesse S. and David Lake, Smith's Landing, New Jersey, July 20.

Claim.—"What we claim as our invention is, 1st, The cleaner as above described.

"And lastly, we claim the coupling the wheel to the shaft, with universal joint, constructed with toggle joint arms, to admit of a vertical motion, and with gimble ring, to allow of a rolling or wabbling movement, without affecting its rotary motion, when combined and arranged for the purpose and in manner above described."

50. For an *Improvement in Grass Harvesters;* Wm. Manning, South Trenton, New Jersey, July 20.

Claim.—"Having thus fully described my invention, what I claim as new is, suspend-

ing the cutting head and front part of the machine, whereby I dispense with front wheels, by constructing the frame as described, and attaching the cutting head to the hames of the harness, in the manner and for the purpose herein fully set forth."

51. For *Improvements in Sewing Machines;* Charles Miller, St. Louis, Missouri, July 20.

"This invention relates to that description of sewing machine which forms the stitch by the interlacing of two threads, one of which is passed through the cloth in the form of a loop, and the other carried by a shuttle through the said loop; it consists, 1st, in an improved stop motion, or certain means of preventing the feed or movement of the cloth, when by accident the thread breaks or catches in the seam; and, 2d, in certain means of sewing or making a stitch similar to what is termed in hand sewing, 'the back stitch.'"

Claim.—"Having fully described my invention, what I claim as new is, 1st, The stopping or prevention of the operation of the feed, substantially as herein described, when the thread breaks or is otherwise prevented from forming a loop, by attaching the stud or its equivalent, through which the feed lever is operated upon by the feeding cam, to a lever; the said lever being subject to be operated upon in such a manner as to withdraw the said stud, or equivalent, from the operation of the cam, by a sliding piece attached to the picker, which drives the shuttle forward for filling; the said sliding piece requiring to be caught and moved by every loop, to prevent its operation in the said lever.

"2d, Sewing or making the back stitch by folding or bending the cloth or material over the edge of a guide plate or any other suitable edge, and passing each loop through the cloth or material on each side of the said bend and each succeeding loop through, in advance of the preceding one, and half-way between the two preceding perforations, substantially as herein set forth."

52. For an *Improvement in Grain Separators;* Cyrus Roberts, Belville, Illinois, July 20.

Claim.—"Having thus described my improvements in grain separators and cleaners, what I claim therein as new is, the combination of the adjustable crank for vibrating the separating trough, with the adjustable tracks on which the jumping roller runs, which shakes the trough up and down, whereby the conveyance of the straw may be accelerated or retarded, without affecting the vertical shaking of the straw.

"I also claim the adjustable angular rails, constructed and arranged in the separating trough, in the manner and for the purposes herein set forth.

"I likewise claim the method herein described, of relieving the winnowing apparatus of a portion of the work, by separating, by means of a screen, arranged substantially as herein set forth, such impurities as will pass through it before the grain is delivered to the winnowing apparatus."

53. For an *Improvement in Railroad Car Brakes;* John Houston and Ebenezer Ross, Manchester, New Hampshire, July 20.

Claim.—"What we claim as our invention is, the arrangement, substantially as set forth, of the levers, rods, and vertical shaft, applied to each truck of a railroad car, in combination with the method of connecting the levers by means of the links, so that if one or more of the links or bars should break, so as to render part of the brakes useless, the remainder are still serviceable for the purposes intended."

54. For an *Improvement in Machines for Rubbing Stones;* Pleasant E. Royse, New Albany, Indiana, July 20.

Claim.—"I do not claim the separate employment of a rotary rubber and blocking tables, as such are in common use; nor do I claim, of itself, giving the rubbers a separate motion, in addition to their revolving one, by means of pinions gearing into a fixed wheel, and through cranks and connecting rods, serving to operate the rubbers, as such has before been done; but what I do claim as my invention is, the combination of parts herein specified, for rubbing and polishing marble or other stone, consisting of rubbers, having in addition to their revolving travel on the faces of the stones being rubbed or polished, a motion in and out from the centre shaft, not in a radial, but in a winding, twisting, or curvilinear direction, produced by the cranks and rods as shown and set forth; the said rubbers being held in clamps, so hung or connected, as that the rubbers, by their weight, will adjust themselves to the stone, without rendering it necessary to pack up the latter, and for the further advantages specified."

55. For an *Improvement in the Water Pipes of Tuyeres;* Peter Sweeney, Buffalo, New York, July 20.

"The nature of my invention consists in combining with the circulating water pipe for cooling the tuyere, another pipe, by which I am enabled to shut off the circulation of water and blow the water out of the circulating pipe; the object of my invention being to avoid the evils which arise from the freezing of the water in the circulating pipe of the tuyere in cold weather."

Claim.—"What I claim is, the combination of the pipe, H, with the circulating pipe, P, V, Q, so connected that H may be removed from, or form a water tight joint with P, V, Q, whereby I am enabled to blow all the water out of the latter, and at the same time to shut off its communication with the cistern, in the manner and for the purposes described."

56. For an *Improvement in Railroad Car Coupling;* James Turner, East Nassau, New York, July 20.

Claim.—"What I claim as my invention is, the transverse incline bar, in combination with the coupling pin and link, the pin resting on the incline bar, and being raised clear of the link, by passing up the inclines on the said bar, as it (the pin) moves sideways, substantially as herein described."

57. For an *Improvement in Preparing Zinc from the Ores;* Henry W. Adams, City of New York, July 27.

Claim.—"Having thus fully described the nature of my invention or discovery, and shown the method in which it may be accomplished, what I claim therein as new is, the process of manufacturing metallic zinc, in a state of impalpable powder, by the cooling agency of steam, substantially in the manner herein set forth."

58. For an *Improvement in Machines for Forming Button Backs;* James C. Cooke, Waterbury, Connecticut, July 27.

Claim.—"What I claim as my invention is, the jointed clamps, and the tongue, to form the eye, when combined with the slide with its stationary and movable jaws, when the movable jaw and slide are worked by a jointed lever to feed the wire, when they are constructed and made to operate substantially as herein described.

"I also claim the die for punching and forming the button back, composed of the punch and bed, when combined with the slide and feeding cylinder, when constructed and operated substantially as herein described.

"I also claim the jointed fingers for receiving the formed and punched back, and conveying it to and placing it on the eye, when combined with the setting or riveting punch, when they are constructed, combined, and arranged, and made to operate, substantially as herein described."

59. For an *Improvement in Saws for Sawing Stone;* Albert Eames, Springfield, Massachusetts, July 27.

"The nature of my invention consists in making the blade with the middle part of its thickness, of lead or other soft substance, so that sand shall become imbedded into it, and remain there during the operation, to act upon, and break down, or cut away the stone, whilst the sides or edges, which are made of steel or iron, or other hard metal, will cut down and keep the kerf of the proper width, and prevent the lead or other soft substance, from spreading out or yielding."

Claim.—"What I claim as my invention in the making of blades for cutting stones is, the employment of lead, or its equivalent, between and in combination with the hard metal sides, substantially as specified."

60. For an *Improved Churn and Butter Worker;* Orsamus R. Fyler, Brattleborough, Vermont, July 27.

"The nature of my invention consists in combining revolving floats or dashers, with stationary posts, between which the dashers revolve."

Claim.—"What I claim as my invention is, 1st, the combination, in a cylindrical or tub churn, of floats or paddles, attached to a revolving axis, with stationary posts standing near the axis of the churn, combined and operating in the manner and for the purpose above specified.

"2d, The combination of dashers, or paddles, broad at their ends, with posts small at each end, and large in their middle portions, combined and operating in the manner and for the purpose above specified."

61. For an *Improvement in Fastenings for Harness;* Thomas Henderson, Harford County, Maryland, July 27.

Claim.—"Having thus fully described my invention or improvement, I wish it to be understood that I do not claim, in general terms, the use of a crooked lever and ring, for these have been applied before to this purpose; but I do claim as new, the use of this peculiar kind of crooked lever or hook, described above, in which the fulcrum and centre of motion are at the short end, and the point of resistance at the curve and in a straight line with the fulcrum and other end, thereby effecting the desired object within itself, and without the combined aid of plate, spring, rivet, or other fixture; whether the same be applied to the fastening of hames, as described above, or to connecting the ends of chains, as in the case of chains usually fastened across the middle of wagon bodies, or to any similar purpose."

62. For an *Improvement in Duplex Escapements;* Charles E. Jacot, City of New York, July 27.

Claim.—"I do not claim any of the parts herein described or shown; nor do I claim the duplex escapement; but what I do claim as new and of my own invention is, the construction and arrangement of the escapement wheel with three points and pins to take the arm on the balance axis; the whole being constructed and operating substantially as described and shown."

63. For an *Improvement in Seed Planters;* Adam Kraber, York, Pennsylvania, July 27.

Claim.—"What I claim as my invention is, the combination of a series of stationary combs, secured to the bottom of the hopper, near the orifices, through which the grain is discharged with a corresponding series of rotating teeth, secured to a cylinder or roller, that revolves within the hopper, in the manner and for the purposes herein set forth.

"I also claim the combination of the cross bar, and its links and levers, with the draft bars of the shares, whereby the whole series of shares can, at will, be raised and depressed, while the machine is in motion, and the weight of the whole machine is brought to bear upon any tooth that may tend to run out, in consequence of meeting with hard soil, while, at the same time, an even depth of furrow is maintained by the wheels, and the weight of the frame taken off the shares, except when some one of them tends to run out, as herein set forth; but I make no claim to any arrangement of mechanism, for holding the teeth or shares in the ground, when the pressing bar acts upon the teeth through the medium of springs."

64. For an *Improvement in Soaps;* William M'Cord, City of New York, July 27.

Claim.—"I am well aware that "fuller's earth" being used for a soap, from time immemorial, also of various clays having been used for detergent purposes; I am also aware that ammonia has been employed in soap, and a patent has been issued, in which it forms one of the ingredients; but in all cases, so far as I have seen it used, it has never been held in good combination with the other ingredients in the soap, but has, owing to its volatile nature, soon evaporated. As combined with the clay, by my process, the ammonia is retained in the soap, and does not evaporate. What I therefore claim is, the combination of ammonia, or carbonate of ammonia, with kaolin, or other equivalent aluminous minerals, in the composition of a soap, substantially as herein set forth."

65. For *Improvements in Railroad Track Clearer;* Simeon Minkler, Chazy, New York, July 27.

Claim.—"I do not claim the grapples which are attached to the engine, car, or carriage, and embrace the top flanch of the rail; but what I do claim is, keeping the said grapples closed upon the flanch of the rail, by the collar which drops over their joints, and opening the same by chains, or their equivalents, attached to the said collar and to the grapples, under the control of a person on the engine, car, or carriage, said chains or equivalents lifting the collar, so as to leave the grapples free, and then opening them, substantially as herein set forth."

66. For an *Improved Block for Stretching Coats;* Samuel M. Perkins, Springfield, Pennsylvania, July 27.

Claim.—"Having now described my invention, what I claim is, the use of the seamless coat stretcher, made in two halves and joined together by hinges at their back edges, and having permanent or adjustable arms attached thereto, and hooks for holding the edges of the cloth, while stretching, spring hook, or catch and pin, for holding the halves of the machine together, and steadying pins, in the face of the two halves, in combination therewith, substantially as set forth."

67. For an *Improvement in Railroad Car Seats;* Samuel M. Perry, City of New York, July 27.

Claim.—"What I claim as my invention is, to so combine the back with the two end frames by means of bars jointed to it, one or two studs, and one or two series of notches or equivalents therefor, that the said back (when not a reversible one) may be raised and inclined in various positions, so as to not only support the back but the head of a person at the same time.

"And I claim making the back reversible by means of two series of notches, and two sets of studs, or equivalents, the same being arranged on opposite sides of the chair, and made to operate as specified.

"And in combination with the back made to raise and be inclined, by contrivances substantially as specified, I claim the improvement of making each bar with a rack or racks of teeth, or succession of notches, to be set on the pin, in the manner and for the purpose as specified."

68. For an *Improvement in Mortising Machines;* William C. Shaw, Madison, Indiana, July 27.

"The nature of my invention consists in providing the machine with suitable mechanism, for the purpose of enabling the operator to turn the chisel by means of the machinery employed for the purpose, and not by hand, as is commonly done."

Claim.—"What I claim as my improvement is, the method I employ of turning the mandrel that contains the mortising chisel, by means of the collar on the mandrel, springs, catches, shifting piece, friction rings, and pinion, all in combination for the purpose heretofore mentioned and set forth in the foregoing specification."

69. For an *Improvement in Lamps;* Charles Siedhof, Lancaster, Massachusetts, July 27.

Claim.—"What I claim as my improvement is, the open slide tube, as combined with the supply reservoir of a lamp, constructed and made to operate substantially as described; the object of such tube being not only to maintain the oil at a constant level around the wick, but to enable a person to regulate the height of such level at pleasure."

70. For an *Improvement in Graduated Cutters for Cloth and other Substances;* Halsey D. Walcott, Boston, Massachusetts, July 27.

"This improvement consists in making the bed longitudinally adjustable, in relation to the cutter, (or vice versa,) so as to vary the length of the cutting edge, which shall come in contact with the bed, and consequently the length of the incision that will be made by them."

Claim.—"What I claim as my invention is, the employment of a cutter and bed, or their equivalents, made adjustable in relation to each other, in the direction of the cutting edge, for the purpose of varying the length of the cut, substantially in the manner herein described."

71. For an *Improvement in Compounds for Uniting Steel and Iron;* Boyd C. Leavitt, Assignor to Joseph H. Bishop and H. Libbey, Newport, Maine, July 27.

Claim.—"I wish it understood I do not claim the use of crude borax, either pulverized or not, for the union of metals, as this has been used for the purpose by others; but it does not insure a perfect union, and cannot be relied upon with any degree of certainty, and great loss of time and material often occur, as a ready separation of the two, even after a seeming union, and the particular work seems complete, and ready for the use intended; but what I do claim as my invention or discovery is, the mode and manner of calcining and preparing the crude borax, and compounding the same afterwards, with the carbonate of ammonia, and in the proportions above set forth and described, and the mode of applying or using it, or any other substantially the same, and which will produce the intended effect."

72. For an *Improvement in Brooms;* Cyrus T. Moore, Assignor to Friend S. Noyes, Concord, New Hampshire, July 27.

Claim.—"What I claim as my invention is, 1st, securing the material of the broom, by means of a clasp having its jaws hinged at the extremities, and fastened together at the socket, or some equivalent device, substantially as herein set forth.

"2d, A spring or springs, whether placed as herein described, inside of the brush or material composing the broom, or otherwise, so as to operate in substantially the same manner.

"3d, The cross, fastened to the spring with spurs, or otherwise, in combination with the loop, to hold the brush or other material in its proper place, as described."

RE-ISSUES FOR JULY, 1852.

1. For an *Improvement in Bedsteads;* Nathaniel Colver, Abington, Massachusetts; patented April 24, 1849; re-issued July 6, 1852.

Claim.—"I lay no claim to a combination of rest bars or boards, spiral or wound wire springs, a sacking and closing frame, used to support a cushion or mattress; such a combination having been employed in the manufacture of sofas and other articles of furniture: but what I claim as my invention is, the method in which I construct the foundation of the bed or mattress, by means of the above described pliances or their equivalents, to wit: the lacing and the clamps and keys, or wedges, so as to render the bedstead portable, by being taken apart, or enfolded, the one part over the other, or united together, or unfolded, as above described, as occasion may require, that is to say, I claim the combination of the two frames, or halves of a box, each of said frames or halves consisting of a side, two ends, and bottom, or slats, supporting wire springs, and a sacking affixed to its side and two ends, and supported on springs or stuffing, as occasion may require, and these halves or parts so united that when together, or unfolded, they form but one box or frame, supporting or holding fast the sacking at its entire extremity, without any separating or supporting partition in the centre, and this union or junction of the two posts is effected by the above described lacing, or its equivalent, and clamps and keys or wedges, or their equivalent.

"I lay no claim to any one of the elements of the aforesaid or above described combinations, when separate from the rest; but intending only to claim the whole, as combinations, constituting a bedstead, or foundation for a bed or mattress, to which the parts as above described, or their equivalents, may be applied as aforesaid."

2. For an *Improvement in Machines for Tonguing Boards;* Ransom Crosby, Jr., Assignee of Ransom Crosby, Assignee of Henry D. Edgcomb, City of New York; patented April 13, 1852; re-issued July 13, 1852.

Claim.—"I am aware that Harvey Law has described in his patent of 10th April, 1849, a mode of tonguing, in which two sets of saws are arranged in a frame, with the cutting teeth opposite, and cutting in one plane on opposite faces of the board; none of which devices we desire to claim. But what I do claim as the invention of Crosby and Edgcomb is, the employment of two independent sets of independent cutters, arranged in parallel planes in parallel stocks, with an open space between them, so as to cut on the edge of the board, all in the manner substantially as described, whereby I have the advantage combined of freedom from clogging, and the facilities of adjusting the stocks and cutters for sharpening, setting, and inspection."

DESIGNS FOR JULY, 1852.

1. For a *Design for a Parlor Stove;* Jeremiah D. Green, Assignor to Alexander Morrison and Thomas M. Tibbitts, Troy, New York, July 6.

Claim.—"What I claim as new is, the ornamental design and configuration of a parlor stove, the same as herein described and represented in the annexed drawing."

2. For a *Design for a Cooking Stove;* Wm. F. Pratt and Geo. W. Bosworth, Milford, New Hampshire, July 13.

Claim.—"What we claim as our invention or production is, the ornamental design for a cooking stove, substantially as represented in the accompanying drawings.

"And we also particularly claim the combination of the star, shield, and radial lance heads, as exhibited in the panel of the larger door of the side plate."

3. For a *Design for a Cooking Stove;* Saml. D. Vose, Albany, New York, July 13.

Claim.—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments, as arranged together, the whole forming an ornamental design for an air tight cook stove, as herein set forth and described."

4. For a *Design for a Hat and Umbrella Stand;* Charles Zeuner, Assignor to M. Greenwood & Co., Cincinnati, Ohio, July 13.

Claim.—"What I claim as my invention is, the new design for a hat and umbrella

stand, consisting of the ornamental figures above set forth and represented in the accompanying drawings."

5. For a *Design for a Portable Grate;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, July 13.

Claim.—"What I claim as my production is, the new design, consisting of the gothic arches, mouldings, pendants, &c., herein above described and represented in the drawings, for a portable grate."

6. For a *Design for Parlor Stove Plates;* Amos Paul, South Newmarket, New Hampshire, July 20.

Claim.—"What I claim as my production is, the new design, consisting of the mouldings, raised points, vine and leaf work, herein above described and represented in the drawings, for the top, bottom, and side plates of a parlor stove."

7. For a *Design for the Front and Side Plates of a Cooking Stove;* Dutee Arnold, Providence, Rhode Island, July 27.

Claim.—"What I claim as my production is, the new design, consisting of the mouldings, spear heads, and stars, with rosettes, herein above described and represented in the drawings, for the front and side plates of a cooking stove."

8. For a *Design for a Medallion of Daniel Webster;* Peter Stephenson, Boston, Massachusetts, July 27.

Claim.—"What I claim is, the design of a medallion of Daniel Webster, as represented in the drawings above referred to."

ADDITIONAL IMPROVEMENTS, FOR JULY, 1852.

1. For an *Improved Process for Mashing Maize;* Frederick Seitz, Easton, Pennsylvania; patented June 20, 1852; additional improvement dated July 13, 1852.

Claim.—"Now what I claim as my additional invention, and desire to add to my former patent, granted January 20th, 1852, is, forcing cold air into the distillery mash, through the hollow shaft arms and rakes, agitators, as above described, or by forcing it by a pipe or pipes into the bottom, or near it, of any common mashing machine or tub."

2. For an *Improvement in Metallic Heddles;* Jacob Sennefl, Philadelphia, Pennsylvania; patented January 13, 1852; additional improvement dated July 20, 1852.

Claim.—"Having thus described my improvement, what I claim as my invention, and desire to have added to my patent, is, casting eyes of harness or heddles upon single or multiplied strands of worsted, silk, cotton, thread, or other material, in the manner and for the purpose herein set forth."

AUGUST.

1. For an *Improvement in Railroad Car Seats;* Charles P. Bailey, Zanesville, Ohio, August 3.

"The nature of my invention consists in combining with a permanent seat, a divided back, so arranged as that each part shall swing around the end of its respective part of the seat, when it becomes necessary to reverse the backs, and so that both parts of the back may be reversed, or only one part, leaving the occupants to sit tete-a-tete."

Claim.—"Having thus fully described my invention, what I claim therein as new is, in combination with a permanent seat or seats, a divided back, which is so constructed that one part thereof shall swing around one end of the seat, and the other part around the other end thereof, the back retaining always its upright position, and by which arrangement the two parts of the back may be entirely reversed, or they may be left tete-a-tete, substantially as herein described."

2. For an *Improvement in Looms for Weaving Figured Fabrics;* Cornelius W. Blanchard, Clinton, Massachusetts, August 3.

Claim.—"I do not claim the application of the above named levers to the trap or knot boards of the jacquard loom; but what I do claim therein as new is, 1st, The opening or raising and depressing the harness, by means of levers or bars, oscillating about a fixed point or points, in connexion with hooks or their equivalents, which catch upon these levers or bars, and which constitute a part of the connexions between the top and bottom

jack levers, cords, or other devices, for raising and drawing down the harness, thus raising or depressing the heddles, in a greater or less degree, according as they are more or less distant from the fell, or cloth making point, the motions of the harness all commencing and ending at the same time, as herein substantially described.

"I also claim the method as described, of arranging and combining the parts for moving the figuring chain or cylinder with the other parts of the machine, so as to carry the said chain or cylinder back as well as forward, as the machine is made to move backward and forward."

3. For an *Improvement in Pressure Gauges;* Eugene Bourdon, Paris, France, August 3; patented in France, June 18, 1849.

Claim.—"Having now described my invention, I wish it to be understood that I claim the application of curved or twisted tubes, whose transverse section differs from a circular form, for the construction of instruments for measuring, indicating, and regulating the pressure and temperature of fluids, substantially as above described."

4. For an *Improvement in Dumping Wagons;* Thomas Castor, Frankford, Pennsylvania, August 3.

"My invention consists in balancing the body of a wagon, at or about its centre, on a roller that projects upward from the frame of the running gear, and serves as a fulcrum and sliding point for the body to turn and run on, to facilitate the dumping of its load, and its replacement in the loading position."

Claim.—"Having thus described my improved dumping wagon, what I claim therein as new is, the arrangement of the body on a fixed roller fulcrum on the frame of the running gear, in such manner that by a slight amount of force the body can be turned, to give its under side, which rests on the roller, either a forward or backward inclination, to cause the weight of its load to tend to hold it forward or back, as it is required to carry or to dump the same, substantially as herein set forth."

5. For an *Improved Tally Board;* Francis N. Clark, Chicago, Illinois, August 3.

"The nature of my invention consists in having a series of screw rods properly secured over a board, said screw rods having nuts upon them, which are moved either to the right or left, according as the rods are turned upon the board, and underneath each nut there is a space, which is graduated in any proper manner; by turning either screw rod, the nut on the rod is moved, and the graduated space shows how far the nut has moved and the amount tallied."

Claim.—"I do not confine myself to any particular form or manner of arranging the screw rods over the board, nor to any particular manner of graduating the spaces; but what I claim as new is, the manner of tallying or keeping an account of articles, as they are delivered or moved, by means of screw rods, having nuts upon them, said nuts being placed over graduated spaces, which indicate the distance the nuts have moved, or give the number of turns or half turns of the rods; the rods, nuts, and spaces being arranged as shown and described, or in any other manner substantially the same."

6. For an *Improvement in Casting Stereotype Plates;* Hobart P. Cook, Albany, New York, August 3.

"The nature of my invention consists in using, by means of appropriate mechanical arrangement, the power of compressed air or of steam, in the casting of stereotype plates; thereby insuring greater rapidity in the process of casting, with a decreased liability of injury to the plates while being cast, and at a much reduced cost of production."

Claim.—"What I claim as my invention is, the manner of casting stereotype plates, by the application of pressure upon the surface of the melted metal in the inner kettle, which pressure forces the metal, while fluid, through a tube and upon the mould, the face of the mould being turned down to receive the metal making the casting; the whole acting substantially in the manner and upon the principles set forth and described in the specification."

7. For an *Improvement in Compositions for Preserving Butter;* Louis De Corn, Cincinnati, Ohio, August 3.

"By my process, any quantity of butter can be preserved, indefinitely, fresh; I mean, can be preserved always fresh for any length of time."

Claim.—"What I claim as my invention is, the preservation of fresh butter, for any length of time, as herein described, using for that purpose the aforesaid chemical compound, or its equivalent, substantially in the manner and for the purpose set forth."

8. For an *Improvement in Looms for Weaving Figured Fabrics;* Samuel and James Eccles, Kensington, Pennsylvania, August 3.

Claim.—"What we claim as constituting our invention is, 1st, The star movers, whether they be arranged to slide, instead of the star wheel, or otherwise, and neutral surface, in combination with the star wheel, (sliding or otherwise,) arranged substantially in the manner and for the purpose herein specified.

"2d, We claim the pins, or pattern plates, or their equivalents, in combination with the diamond shaped projection, or four sided inclined plane, lever, and star wheel, arranged substantially as described, for the purposes herein specified.

"3d, We claim the guide, in combination with the star movers and star wheel, as described.

"4th, We claim the combination formed by the mechanism herein described, for giving a positive and correct motion to the jacquard card cylinder, that is to say, the star mover, star wheel, and connecting arms, with mitre wheels, or their equivalents, as herein fully made known, and the above mechanism is also intended to be applied to other description of looms where lags and other similar devices are used, instead of the cards, as on barrel and other similar looms; therefore, the claim is not limited to the turning of a jacquard card cylinder."

9. For an *Improvement in Adjusting the Chasers in Screw Cutting Stocks;* Mitchell C. Gardner, Brockport, New York, August 3.

"The nature of my invention consists in arranging an adjustable band, on which the index is lettered, for adjusting the index to the chasers, the same being adjustable to the wear of the chasers, or to chasers of different lengths, and in combination with suitable apparatus for causing said chasers to approach or recede from a common centre."

Claim.—"Having thus fully described my invention, I do not claim the index, but what I do claim is, the adjustable band, *d*, fig. 4, and *d*, *d*, fig. 5, on which the index is lettered, for adjusting the index to the chasers; the same being adjustable to the wear of the chasers, or to chasers of different lengths; and in combination with suitable apparatus for causing said chasers to approach and recede from a common centre, for the purposes stated.

"And I also claim the shaft, *f*, as shown in figs. 2 and 4; and pinion, H, fig. 2, in combination with pinions, G, G, G, G, fig. 2, and the bevel gear wheel, E, fig. 3, at the outer end of which shaft is attached a crank, to drive the bevel gear wheel, E, fig. 3, as herein before set forth and described, and for the purposes stated."

10. For an *Improvement in Scales for Weighing;* William P. Goolman and William Holtsechaw, Jr., Springtown, Indiana, August 3.

"The nature of our invention consists in making the weighing beam with two long graduated arms, instead of one only, and applying a pea, or weight, to each of them; the divisions on one arm indicating pounds, or tens, or hundreds, &c., of pounds, according to the size of the balance, and those on the other arm, the ounces, quarter pounds, or pounds, or any sub-divisions or fractions of the larger weights that may be desired."

Claim.—"What we claim as our invention is, the making of the weighing beam of platform or other balances, or scales, with two graduated arms, extending in opposite directions from the fulcrum of said beam, and applying one or more movable weights, or peas, to each of them; the divisions on one arm indicating the larger divisions of weight, and those on the other, any sub-divisions or fractions of the larger that may be desired, substantially as herein set forth and described."

11. For an *Improvement in Jacquard Looms;* John Goulding, Worcester, Massachusetts, August 3.

Claim.—"What I claim as my invention is, 1st, connecting the knot and trap boards with, and operating them by levers, arranged substantially as herein described, so that the second row of heddles or harness, shall fall and rise so much farther than the first, and the third than the second, and so on through the entire series of heddles, or harness, that, as the warp is sprung, the threads in the same shed, from each row of heddles, whether front, middle, or back, and whether sprung in the top or bottom shed, all lies substantially in the same plane.

"2d, The apparatus which inserts and draws the wires to form the pile, constructed and operated substantially as described.

"3d, The devices for locking and unlocking the beam or beams containing the warp, substantially as described."

12. For an *Improvement in Ox Yokes;* Ezra Hough, St. Johnsville, New York, August 3.

"By the use of my improved slide yoke, oxen will work much easier, and will not crowd, or haul, as is often the case, in using the ordinary yoke; each ox endeavoring to obtain some advantage over his mate."

Claim.—"I do not claim the slides, independently of their connexion, as they have been previously used; but, having described the nature of my invention, what I claim as new is, the connecting of the slides, in which the bows are secured, by means of the chains and rods; the chains passing over the pulleys, by which neither of the slides or bows can be moved laterally, without communicating a corresponding opposite motion to the other; thus keeping the oxen, at all times, at equal distances from the centre of the yoke, the chains, rods, and pulley, being arranged as shown and described, or in any other manner substantially the same."

13. For an *Improved Elastic Horse Shoe;* John O. Jones, Newton, Massachusetts, August 3.

Claim.—What I claim is, the shoe, formed with two plates, between which a sheet of vulcanized rubber or other elastic substance is interposed, in the manner and for the purpose herein set forth."

14. For an *Improvement in Scythe Fastenings;* Alpheus Kimball, Fitchburgh, Massachusetts, August 3.

Claim.—"Now, I would remark that I do not claim the invention of confining the shank to the snath, by fastening contrivances applied both to the heel and toe of the scythe, particularly when the fastening contrivance of the toe is made to press against the toe, in a direction towards the heel of the scythe, as, under such circumstances, the variation of the angle of the blade and snath is generally limited to certain fixed positions; but what I do claim as my improvement is, to make the fastening bolt of the toe act against the side of the toe, or laterally against the shank, in combination with making it, or the bolt and shank, with the peculiar curved projection, and recess, and the flattened faced stirrup, or confining contrivance of the heel of the shank, so as to allow of the lateral position of the heel being changed, or varied, as specified, whereby the angle of the shank part of the snath and of the blade may not only be varied to any extent within certain limits, but the toe of the shank, as usually made, confined down by other means than that which operates to secure the shank (at its heel) to the snath."

MECHANICS, PHYSICS, AND CHEMISTRY.

Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By Mr. William Bland, *of Sittingbourne, Kent.**

Continued from page 132.

Chapter XI.—Of the Lee Way, or Lateral Resistance.

This property in a ship depends (see experiment 5,) directly upon the perpendicular depth at which it floats, and the length. The following is a course of experiments relative to the lateral resistance of different midship sections or forms, and having reference to the depths of keels.

The midship forms selected for the experiments were those which had been employed in Chapter X., Experiments 41, &c. The diagrams are again given, but with the addition of keels to two of them. The results were measured by the length of lever, not by weights.

c, the centre of gravity, and the dotted lines the depth of flotation.

* From the London Architect for September, 1851.

Experiment 44.

No. 1. Semicircular bottom, } Weight. { Each with ½-inch
No. 4. Elliptic bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 1 resisted most, and equal to 1 inch of lever.

Experiment 45.

No. 1. Semicircular bottom, } Weight, { Each with ½-inch
No. 2. Flat bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 2 resisted most, and equal to 1½ inch of lever.

Experiment 46.

No. 1. Semicircular bottom, } Weight, { Each with ½-inch
No. 3. V or Triangular bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 3 resisted most, and equal to 1 inch of lever, but was disposed to turn over.

Experiment 47.

No. 1. Semicircular bottom, } Weight, { With ½-inch keel.
No. 4. Elliptic bottom, } 1 lb. 13 oz. { With 1 inch keel.

Result.—No. 1 resisted most, and equal to 1 inch of lever.

Experiment 48.

No. 1. Semicircular bottom, } Weight, { With ½-inch keel.
No. 2. Flat bottom, } 1 lb. 13 oz. { With 1 inch keel.

Result.—No. 2 resisted most, and equal to 1½ inch of lever.

Experiment 49.

No. 1. Semicircular bottom, } Weight, { With ½-inch keel.
No. 3. V or Triangular bottom, } 1 lb. 13 oz. { With 1 inch keel.

Result.—No. 3 was overturned by the resistance.

Experiment 50.

No. 1. Semicircular bottom, } Weight, { Each with ¼-inch
No. 2. Flat bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 2 resisted most, and equal to 3 inches of lever.

Experiment 51.

No. 1. Semicircular bottom, } Weight, { Each with ¼-inch
No. 4. Elliptic bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 1 resisted most, and equal to 1 inch of lever.

Experiment 52.

No. 1. Semicircular bottom, } Weight, { Each with ¼-inch
No. 3. V or Triangular bottom, } 1 lb. 13 oz. { depth of keel.

Result.—No. 3 resisted, but overturned.

Experiment 53.

No. 1. Semicircular bottom, } Weight, { With ½-inch keel.
No. 2. Flat bottom, } 1 lb. 13 oz. { With ¼-inch keel.

Result.—No. 2 resisted most, and equal to 1½ inch of lever.

Experiment 54.

No. 2. Flat bottom, { Weight, { No keel.
No. 3. V or Triangular bottom, { 1 lb. 13 oz. { No keel.

Result.—The resistance equal.

Experiment 55.

No. 1. Semicircular bottom, } Weight, { No keel.
No. 3. V or Triangular bottom, } 1 lb. 13 oz. { No keel.

Result.—No. 3 resisted most, and equal to 4 inches of lever.

Experiment 56.

No. 3. V or Triangular bottom, } Weight, { No keel.
No. 4. Elliptic bottom, } 1 lb. 13 oz. { No keel.

Result.—No. 3 resisted most, and equal to 6 inches of lever.

Experiment 57.

No. 1. Semicircular bottom, } Weight, { With ½-inch keel.
No. 2. Flat bottom, } 1 lb. 13 oz. { No keel.

Result.—No. 2 resisted most, and equal to 1½ inch of lever.

Experiment 58.

No. 1. Semicircular bottom, } Weight, { With 1 inch keel.
No. 4. Elliptic bottom, } 1 lb. 13 oz. { With ½-inch keel.

Result.—The resistance was equal, but No. 1 overturned.

Observations on the Results of the Lateral Resistance of the Four Models.

No. 1 resisted most with a depth of keel of ½-inch.

No. 2 resisted most with a depth of keel of ¼-inch, ½-inch, 1 inch, and no keel.

No. 3 resisted most with no keel.

No. 4 was beat in every instance when tested against either of the others with equal depth of keel; but was equal to No. 1 when that had 1 inch keel and No. 4 had ½-inch keel.

Again, No. 1 possessed the least resistance with 1 inch of keel.

No. 2. The variations in the depth of keel made no difference.

No. 3 had the least resistance with 1 inch of keel.

No. 4 had the least resistance with no keel.

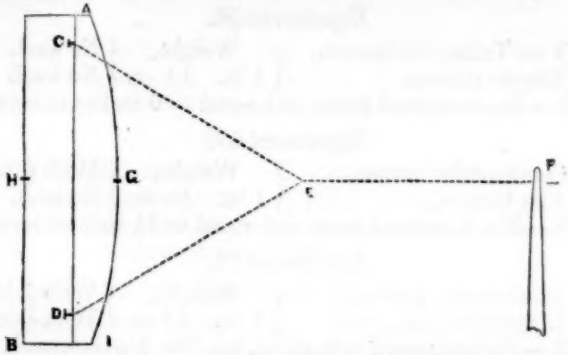
The scale of superiority appears to be thus—

No. 2, the flat bottomed, most decidedly the best, or . . . 1.
No. 1, the semicircular bottomed, ... 2.
No. 4, the elliptic-bottomed, ... 3.
No. 3, the triangular bottomed the most dangerous, except with no keel, ... 4.

On turning to the diagrams it will be seen that the centres of gravity of Nos. 2 and 4 are lower than those of Nos. 1 and 3. Again, the lines of flotation of Nos. 2 and 4 are likewise lower than Nos. 1 and 3. This being the case, the lateral leverage of Nos. 2 and 4 above the water is greater than that of the other two; and their leverage is, on the contrary, greatest in the water, particularly the triangular bottom. No. 2 floats higher than it would have done, had it not been made hollow in part to reduce its weight down to the others.

The mode by which the lateral resistance was tested will be clearest understood by the inspection of the accompanying diagram. A B represents the upper surface of the models, being 14 inches long and 4 inches wide at G H; C, and D, the two rails to which the lines, C E,

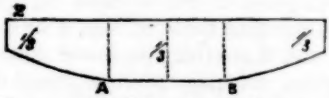
and D E, were attached; E F, is the single line fixed on the end of the balance rod, F. The sides of the models were rounded off as A G I, to prevent oscillation whilst being drawn through the water; at the same time, partaking more of the usual form of the sides of a ship.



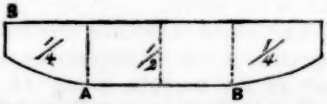
Whilst carrying out these experiments on lateral resistance and keels, many instances occurred of the superior effects in the lengthening of a keel, over the deepening of one. The deepening of a keel acts directly and powerfully to overturn—not so the lengthening; and although a small addition in depth may and does, under certain circumstances, improve a ship's lateral resistance, yet, if the depth be much increased, it so militates against the object sought by the great inclination which ensues, consequent on the force of lateral resistance, as to be altogether injurious.

The next experiments were taken to ascertain the effects, as regards speed, of curving up the bottoms of vessels from the midship or mid length, to both head and stern as high as the load water line; or commencing the same at one-third or one-fourth of the length of each, and leaving the middle one-third or one-fourth of each quite straight or uncurved.

Experiment 59.—A model, 14 inches long, 4 inches wide, and 2½ inches in thickness, weight, 30 oz.; curved from middle length to head and stern, as No. 1.



Experiment 60.—The model, No. 2, of the precise length, breadth, depth, and weight, as No. 1, but having the bottom, A B, one-third of the length, quite level or straight.



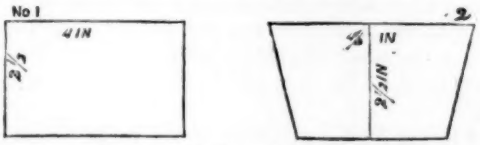
Experiment 61.—The model, No. 3, of the same dimensions, &c., as the preceding, but with the bottom, A B, left flat half of the length.

Result.—No. 1 beat in speed No. 2, by $1\frac{1}{4}$ oz. extra weight; No. 2 beat in speed No. 3 by 2 oz. extra weight; therefore, No. 1 beat in speed No. 3, by $3\frac{1}{4}$ oz. extra weight.

Experiment 62.—This experiment was undertaken to ascertain what might be the advantage, as regards stability, by constructing a ship with projecting sides, instead of carrying them up perpendicularly.

Two models were made, each 15 inches long, $2\frac{1}{2}$ inches deep, with flat bottoms; but one of them 4 inches wide, and perpendicular sides, the other being in width at the bottom at midships $3\frac{1}{2}$ inches, and across the top $4\frac{1}{2}$ inches, and making an angle from the perpendicular of 11°.

Sections of the Models taken at the midships.



Scale, $\frac{1}{2}$-inch to 1 inch; weight of each, 40 oz.

These models were first tested upon the water, each in solid wood, when the stability of each equalled 3 oz. But when a part of the upper insides of both the models was hollowed out, which reduced their respective weights to 33 oz., the stability of No. 1 equalled $3\frac{1}{2}$ oz., and that of No. 2, 3 oz. only.

Let it be observed, that before either of the models were lightened, No. 1 sank in the water $1\frac{1}{4}$ inch, and No. 2, $1\frac{3}{8}$ inch. After being lightened, No. 1 sank in the water $1\frac{1}{8}$ inch, and No. 2, $1\frac{1}{4}$ inch.

The result of lightening the weight of each model from the upper part was the lowering of their centres of gravity, which at once became apparent in No. 1, by its increased stability. But the same result did not follow in No. 2, because of the diminished width of the lower line of its flotation. This proves, most clearly, that the mere lowering of the centre of gravity acts with far less effect, with respect to the increase of stability, than the widening of the beam, or preserving the same as in No. 1.

Of the Rudder.

The rudder is a flat frame-work of timber, ascending perpendicularly from the bottom of the keel, to a distance above the surface of the water, sufficient to admit of a lever being fastened to it in nearly a horizontal position, to move the same either to the right or left; it being so attached to the stern post by means of hooks and rides, or similar contrivances, as to admit of such lateral motion.

The purpose of the rudder is to alter the direct course of a vessel, when its body is going through the water, and into any position the helmsman may desire. That the rudder may act with full effect, it is necessary for the water to have as direct and unimpeded a course against either of its sides, as it is possible to allow. The wider the body of the rudder is made, the greater the power; but in general, it does not much exceed in sailing vessels one twenty-eighth part of a ship's length.

Of the Keel.

The keel is that part of a boat or ship, which is situated at the bottom on the outside, and extends in a direct line from the cut-water at the head, to the post at the stern, descending perpendicularly down below the hull to the depth of several inches or feet according to the size of the vessel. Its uses are, first, to cause the floating body, say of a ship, to preserve a direct course in its passage through the water; second, to act as a check to lee-way; third, to moderate the rolling motion.

Ships formed with flat bottoms, and particularly if they be constructed with parallel sides, require little depth of keel to preserve a direct course; and in order to check the lee-way, a substitute for a keel is applied in the form of a sliding keel, suspended over the lee side, as seen in barges. But when the bottoms of vessels are not flat, or do not draw the same depth of water at the head and stern, particularly the latter, the keel becomes more essential, or the ship will have a rotary motion and be under no command.

With regard to the depths of keels, it will be needless to repeat what has already been given in the experiments, from 48 to 58, Chapter XI.

(To be Continued.)

Translated for the Journal of the Franklin Institute.

New Method of Magnetizing Steel. Letter of Mr. Hamann.

While studying the construction of electro-magnetic apparatus, I looked for the means of making very energetic magnets. I have discovered a new method of magnetizing steel dry-tempered, which is in some degree the opposite of the ordinary method. I magnetize first and temper afterwards. I cause a magnet or an electric current to act on the steel heated to redness, and I temper it while in this condition. The experiment is very simple; by taking a small bar of steel of 3 millimetres square by 6 centimetres long, (0·1 in. by 2⅓ inches,) heated to redness with the pole or between the poles of a magnet, to which at a certain temperature it will remain attached, and plunging the whole into water. In this way will be obtained a small magnet of considerable energy. English refined cast steel, which tempers at a relatively low heat, appeared to me the most suitable for these experiments. I operated with advantage, as compared with other modes of magnetizing, upon bars 12 millimetres (0·4 in.) broad, 6 mm. (0·2 in.) thick, and 17 centimetres (6·7 in.) long. I propose to follow up my experiments, and I believe that the simple fact of the magnetizing of steel before tempering it, is of a nature to interest those who occupy themselves in this branch of physical science.—*Comptes Rendus de l'Academie des Sciences, (Paris,) 29th March*, 1852.

Note.—In *Silliman's Journal* for 1839, Vol. xxxvi. p. 335, will be found an interesting account by J. Lawrence Smith, of his experiments with the above process of magnetizing steel bars, in which he carried it further into successful practice than Mr. Hamann seems to have done. Something resembling it must be also the method of Mr. Faber, by which the magnets of his steam gauge are enabled to resist temperatures, at which the force of bars treated in the usual way, is altogether lost. It would be very desirable to have a detailed description of Mr. F.'s processes and experiments.

For the Journal of the Franklin Institute.

On the Telegraphic Lines of the World. By Dr. L. Turnbull.

Continued from page 138.

United States.

Before concluding my list of the lines in the United States, I received the following interesting account of the telegraph in Ohio, showing the rapid progress which it is making in the West, for which account I am indebted to the politeness of J. H. Wade, Esq., of the "Wade Telegraph Office," Columbus, Ohio.

	Miles.
Cleveland and Cincinnati Telegraph Company, with two lines on separate routes, with an arm from Newark to Zanesville, and another from Mansfield to Sandusky; length of line,	640
Cincinnati and Sandusky Telegraph Company, line from Cincinnati to Sandusky,	218
Scioto Valley Telegraph Company, line from Columbus to Portsmouth,	90
Columbus and Lancaster Telegraph Company, line from Columbus to Lancaster, 25 miles, and an arm to Logansport, 15 miles,	40
Pittsburg, Cincinnati, and Louisville Telegraph Company, from Pittsburg to Louisville, two wires on same poles, 280 each, (in Ohio,)	560
Cincinnati and St. Louis Telegraph Company, from Cincinnati to St. Louis,	50
House Printing Telegraph line, from Buffalo to Cincinnati,	325
Erie and Michigan Telegraph Company, from Buffalo to Milwaukie, with two wires as far as Cleveland; length of wire in Ohio,	260
Lake Erie Telegraph Company, from Buffalo to Detroit, with branch to Pittsburg; length of wire in Ohio,	286
Cleveland, Wheeling, and Zanesville Telegraph Company,	225
Cleveland and Pittsburg Telegraph Company; length of wire in Ohio,	90
New Orleans and Ohio Telegraph Company, from Pittsburg to New Orleans; length of wire in Ohio,	260
Ohio, Indiana, and Illinois Telegraph Company, from Cincinnati to Dayton and Chicago; length in Ohio, about	100
Line from Zanesville to Marietta,	66
Total length of wire in Ohio,	3210

Canada.

From O. S. Wood, Esq., Montreal Telegraph Company, I have received the list of the lines in Canada.

	Miles.
The Montreal Telegraph Company's Line extends from Quebec to the Suspension Bridge at Niagara Falls; distance,	155
British North American Electric Telegraph Association, from Quebec to New Brunswick frontier; distance,	220
The Montreal and Troy Telegraph Company, from Montreal to New York State line at Highgate; distance,	47
The Bytown and Montreal Telegraph Company, from Bytown to Montreal; distance,	115
The Western Telegraph Company, from Hamilton to Port Sarnia, at the foot of Lake Huron; not now working; distance,	143
Niagara and Chippewa Line, from Niagara to Chippewa; distance,	14
All the above lines have single wires.	
In course of construction, a line from Brantford to Simcoe and Dover; distance,	33
Also, a line from Kingston to Hamilton, via. Prince Edwards Co.; distance,	256
Total length in Canada,	983

England.

The English telegraphs come next in extent to those of the U. States; they were first established in 1845, and may be divided into two classes, the railway and the commercial. The railway telegraphs are used for the purpose of sending communications relative to railway matters, while the commercial are employed for the transmission of public and private messages at fixed rates of charges. They are mostly built on the railroads, and in some instances a railroad company will construct a line, and give the use of it to a company, and as an equivalent, the telegraph lends its aid to expedite the business of the railroad. The telegraph company between London and Liverpool receives one thousand pounds a year for doing the business of the railroad company, and the railroad people afford them all the facilities for repairing the line, even so far as sending an extra engine, without charge, when there is not a regular train going out soon; and every man employed on the railroad is under instructions to report immediately to the nearest telegraph office, anything he may find to be out of order on the line. In fact, a line of telegraph is almost considered an indispensable part of the equipage of all well regulated roads in England. The instruments principally in use are those of Messrs. Cook and Wheatsone, Jacob Brett, and Brett and Little. There is a line of Bain's Electro-Chemical Telegraph from London to Manchester, and from Manchester to Liverpool. Also, a line of Bain's Electric Telegraph, connecting Edinburgh and Glasgow, a distance of 46 miles: the whole extent of telegraphic lines is estimated at 2225 miles. The principal ones are as follows:

England, Scotland, and Ireland.

I extract from the Manual of Mr. Walker, telegraphic engineer, a list of the linesof the Electric Telegraphs of England, for 1852.

	Miles.	Wires.	Apparatus.
Edinburgh and Glasgow,	47½	5	8
Line of the Tunnel,	1	2	2
Edinburgh and the North Branch to Dundee,	26	3	6
" " " Perth,	6	3	0
Edinburgh and Granton,	3	3	3
Line to Leith,	1½	3	3
Line of Tunnel,	1	2	2
North British,	58	5	8
Branch to Dalkeith,	1¼	2	2
" Haddington,	5	2	2
Line of the Tunnel,	1¾	2	2
York, New Castle, and Berwick.			
New Castle to Berwick,	65½	5	7
York to Darlington,	45	7	15
Darlington to New Castle,	38½	8	14
Branch to Shields,	11	3	2
" Sunderland,	2¼	3	2
" Durham,	2¼	2	1
" Richmond,	9	2	1
Fatfield and South Shields,	19	1	4
Branch to Stockton,	½	1	2
Carried up,	345	64	86

	Miles.	Wires.	Apparatus.
Brought up,	345	64	86
York and North Midland.			
Normanton to York,	24½	0	5
York to Scarborough,	42½	3	5
Branch to Harrowgate,	18	3	2
Hull and Selby,	36	5	5
Hull and Bridlington,	33	3	4
Normanton to the junction at Milford,	10	2	2
Manchester and Leeds,	51	7	24
Preston and Wyre,	20	3	4
Liverpool and Southport,	13½	3	3
East Lancashire,	12½	3	0
Midland Railway.			
Birmingham and Gloucester,	53	7	9
" " Derby,	6½	7	6
" " Derby,	34¾	5	0
Derby and Lincoln,	48¾	3	4
" Rugby,	24½	7	7
" Rugby,	24¾	5	0
Leicester and Peterborough,	4¾	3	0
" Peterborough,	23	5	11
" Peterborough,	25¼	7	0
Derby and Leeds,	73	7	25
Branch to Sheffield,	5	3	2
Leeds and Bradford,	11	6	5
" Bradford,	2¾	3	0
" Bradford line of Tunnel,	1½	2	2
Branch to Skipton,	15½	3	5
London and North Western.			
London to Birmingham,	5	9	0
" Birmingham,	107½	7	10
" Birmingham line of Tunnel,	1	3	2
" Birmingham Inclined Plane,	1¼	6	6
East Junction to London,	½	2	4
Birmingham and Manchester,	80	7	7
Do. do. do.	5	8	0
Junction to Ardwick,	3½	8	0
Manchester and Liverpool,	31½	6	5
Do. do. line of Tunnel,	1½	2	3
South Devon.			
Branch to Torquay,	4	3	2
Newmarket Railway,	17	5	4
Eastern Union,	16¾	5	7
Line of the Tunnel,	2¾	2	3
London to Southampton,	74	4	4
Do. do.	6	6	2
Branch to Portsmouth,	21	4	4
" Gosport,	5	4	1
Southampton and Dorchester,	61	3	7
Branch to Poole,	2	3	2
Eastern Counties.			
London to Brandon,	88½	7	40
" Stratford,	33¾	2	4
Line to Brick Lane,	½	2	3
Branch to Enfield,	3½	2	2
" Hertford,	7	3	3
Cambridge and St. Ives,	14¾	3	5
Ely and Peterborough,	30	5	7
March and Wisbeach,	9	3	2
London and Colchester,	51½	5	13
Carried over,	1611¼	298	368

	Miles.	Wires.	Apparatus.
Brought over,	1641¼	298	368
Forestgate and Stratford,	1¼	1	2
Maldon and Braintree,	12	3	3
Stratford and Junction of the Thames,	2¾	3	2
North Woolwich,	2¼	3	2
Norfolk Railway.			
Brandon to Norwich,	37¾	7	19
Do. do.	10¼	1	7
Norwich and Yarmouth,	20	9	0
Branch to Lowestoft,	12	5	0
" Dereham,	12	3	2
Dereham and Fakenham,	12¼	2	2
North Staffordshire.			
Stoke to Norton Bridge,	10¾	3	3
Branch to Colwich,	18¾	2	2
Stoke to Burton,	29½	3	5
" " depot,	¾	2	2
North Staffordshire.			
Stoke to Crewe,	14½	3	4
Harecastle Line of the Tunnel,	1	2	2
Branch to Macclesfield,	19½	3	4
Valley of Churnet,	27	2	0
South Staffordshire,	9½	2	3
Do. do,	2	3	1
Northampton and Peterborough,	47	3	10
Northampton prolongated to Wolverton,	10½	4	2
London and Croydon,	8	3	4
Great Western,	19	4	2
Line of the Streets of London,		variable,	10
Manchester and Sheffield,	2	3	3
Manchester Line of the Tunnel of Woodhead,	3½	3	2
Ambergate, Matlock, and Buxton,	11½	2	3
London and Blackwall,	3½	0	0
Line of Caldon Low Quarry,	3½	1	4
Mines of the coal of Moira,	½	2	2
Maryport and Whitehaven	½	4	4
Line of the Company of Iron Mines of Butterley,	2½	1	2
South Eastern.			
London to Dover,	88	0	29
" Rochester,	31	4	18
" Bricklayer's Arms,	4	2	2
Tunbridge to Tunbridge Wells,	5	3	6
" Hastings Road,	1	2	2
" Laboratory,	0	1	2
Paddock Wood to Maidstone,	10	3	5
Ashford to Ramsgate,	30	3	5
Minster to Deal,	9	3	6
Ramsgate to Margate,	4	3	2
Total,	2190¾	420	558

Their mode of construction in England is very expensive, amounting in some cases to $600 per mile. Posts of fir are ranged at convenient distances along the side of the principal railways; each post is furnished with an insulator of earthenware, and also capped with a wooden roof having dripping eaves to throw the water from the wires. The latter are made of galvanized iron, two of which are needed on a line working with Cook and Wheatstone's instruments.

The press of England use the telegraph but little, and pay heavily for what they get by it. The *London Times* pays one thousand pounds

per annum for a certain amount daily, and in addition, they pay for all extra communications of importance. The charge for transmission of communications by the Electric Telegraph Company's telegraphs in England, is at the rate of one penny per mile for the first fifty miles, and one farthing per mile for any distance beyond one hundred miles. The South Eastern Railway Company's charges for telegraphic communications are even much higher than those of the former. Thus, twenty words transmitted eighty-eight miles is charged the large sum of $2·42. These facts show that telegraph companies, as well as the public at large, would derive much greater advantages from their construction on a more economical plan, like that of the American system. In many parts of the United States where railways do not exist, the wires are stretched across the prairies without any protection whatever, except the general good will of the people at large. The cheap construction of these lines renders them liable to frequent disorder, and consequently needing continual repair, so that perhaps it might have been more economical to have expended more in the commencement. Its advantages are, however, abundantly proved, as the poorest person in the U. States or Canada, is enabled by the low rate of charges to use any of the telegraphs for domestic purposes. A message of twenty words can be sent a distance of 500 miles in the United States for $1, while in England the same would cost from $7 to $8.

Sub-Marine Telegraph, 1852.—A London letter under date of June 4th, says: The chief event of the week has been the laying down of the submarine telegraph between the coasts of England and Ireland, a distance of 64 miles. On the 2d instant, at 4 o'clock in the morning, the operation commenced by the departure of a steamer from Holyhead, and at half past eight in the evening a gun was fired at Dublin by means of the electric wire. The process has been an inexpensive one, and will probably prove remunerative, and lead to the establishment of many other lines. Among these, one of the first will be from the port of Harwich, on the east coast of England, to Holland, a concession for that purpose having lately been granted by the Dutch Government.

A similar communication with Belgium, between Dover and Ostend, is also contemplated. These enterprises will all be carried out by separate interests. The company that first established the practicability of such a method of ocean communication, by laying down the wire between England and France, might have secured all the advantages of the extension of the principle, but their Board of Directors have been incessantly quarrelling among themselves, and have consequently brought their own shares to a discount. In June, 1852, the telegraph between Dover and Ostend was completed; it is seventy English miles long.

Telegraph Extensions, June 27.—Private letters received per Atlantic state that F. N. Gisborne, Esq., the agent of the Newfoundland Electric Telegraph Company, has contracted in England for the land wire, through Newfoundland, upon very favorable terms. Mr. Gisborne has also entered into contracts for the sub-marine line, connecting Newfoundland with Nova Scotia, upon terms much less than estimated. Messrs. Newall & Co. of London, the contractors for the submarine, have also entered into contract to lay down a line from the Hague to Harwich, a distance

of 135 miles, and are now negotiating with the French Government for a line from France to Algiers; a stretch of 400.

Ireland.

An Irish Sub-marine Line Telegraph, between Fort Patrick and Donoughadee, was to be opened on the 10th of June.

A line of telegraph has been opened between Dublin and Galway, and was in operation in June, 1852.

Prussia.

The Prussian Telegraph system is characterized as simple, substantial, effective and economical. A Royal Commission was appointed in 1844, to ascertain the best method of constructing lines; they, after experiment, determined on that of copper wire enclosed in gutta percha, and buried two feet beneath the surface; they are generally made to follow the track of railways, and in passing over bridges or aqueducts, are enclosed in iron piping, or when through rivers in chain pipes. They use but one wire, which terminates in an earth battery, consisting of a zinc plate 6 feet long, 2½ feet wide, and ⅛-th of an inch in thickness. The instruments used are those of Morse, Siemens, Halske, and Kramer, together with Daniel's battery. In the principal offices, a printing and a colloquial instrument are employed, but each in turn is worked by the one wire only, notice being given that one or the other is to be used, according to circumstances. Morse's is the printing telegraph used, and differs but very little from that used in the U. States. Those of Siemens and Kramer are both colloquial telegraphs, but Siemens' is chiefly used. The whole cost, as determined from detailed estimates, is less than $200 per English mile. Besides the government lines of telegraph, most of the railway companies in Prussia, have also their own telegraphs, which are constructed according to the system in this country by one wire suspended on poles along the railways. The average cost of this form of telegraph is about $100 per mile; their whole length is estimated at 1493 miles, having their central point at Berlin, from whence they radiate as follows:

Instruments used.	Stations and points passed through.	Distance in miles.
Siemens and Halske's Patent,	From Berlin to Frankfort on the Main, established in February, 1849,	350
Kramer's Bell Telegraph,	From Berlin through Cologne to Achen, established in June, 1849,	362
	Stations are Potsdam, Magdeburgh, Ochsertleben, Brunswick, Hanover, Minder, Haurm, Dusseldorf, Deutz, Cologne.	
Seimens and Halske's Patent,	From Dusseldorf to Elberfeld,	16
Morse's Apparatus,	From Berlin through Minder to Rolu,	81
Siemens and Halske's,	" " to Hamburgh,	142
" "	" " Stettin,	62
" "	" " through to Oderburgh to Breslau,	280
" "	" Halle to Leipzic,	17
" "	" Leipzic to Berlin,	115
" "	" Leipzic to Frankfort on the Main,	204
Siemens' Telegraph,	" Berlin to Gross Bercen	
" "	A contemplated one from Berlin to Konigsberg to Dantzic.	
Morse Instrument,	From Hamburgh to Cuxhaven,	80

The Prussian method of burying the wires beneath the surface, protects

them from destruction by malice, and makes them less liable to injury by lightning.

Austria.

The Austrian Telegraphs diverge from Vienna, in the following manner:

1, From Vienna through Olmutz to Prague, 237 miles.
2, " " " Bumn " 211 "
3, " " to Pressburgh, 35 "
4, " " through Prevau to Oberberg, 140 "
5, " " " Bruck, Cilli, Layback to Trinte, 284 "
6, " " " Lintz to Saltzburg, 156 "
7, " Prague to the boundary of Saxony, to connect with the line from Dresden, is nearly complete as far as the boundary of Bohemia, on which Storer's apparatus will be used; on the other a modification of Morse's by Robinson, printing about 600 words per hour; also, a modification of Bain's needle telegraph, by Ekling, of Vienna, containing an arrangement of 45 needles, averaging about 190 words of six letters each per hour. The Austrians have adopted this system of correspondence, mostly since 1847; their network of telegraphs extends over a space of more than 1053 miles, having 106 stations, which will be increased to 200 stations, if the present projected lines are constructed. The line from Lintz to Saltzberg, has a connexion with the Bavarian one from Munich to the latter place, and makes use of Stochriss' instrument. A line between Venice and Milan with its branches is already commenced.

Saxony and Bavaria.

Saxony and Bavaria have government lines which connect with the Prussian and Austrian lines, and establish a communication with Berlin, Dresden, Munich, and Vienna. Nearly all the railroad companies have private lines for their own use, and preparations are now making, which in no distant future will include every town of importance throughout Germany in this network of communication.

Those of Saxony extend over 265 miles, the principal of which are annexed: From Leipzig to Hoff, 94 miles; from Leipzig to Dresden, 62 miles; Dresden to Konigstien, 15 miles; Dresden to the boundary of Bohemia; Dresden to Hoff, 94 miles. Stochriss' needle instrument is principally used in this country; likewise, in Bavaria his bell apparatus. The extent of lines in the latter country is about 455 miles. From Munich to Salzburg, 74 miles, connecting with the Austrian lines of Ling and Vienna; from Munich through Augsburgh to Hoff, 226 miles, connecting with the line to Dresden in Saxony; from Munich to Augsburg, 31 miles; one under construction from Augsburg, through Nuremburgh and Bamburgh to Hoff; from Bamburgh to Wurzburg, Aschappenburg, and Frankfort, 125 miles under construction.

Tuscany.

The lines in Tuscany number 120 Italian miles, commenced in 1847, under the direction of Matteucci; they also follow the railroad. From Florence to Livourne; from Empoli to Sienne; from Pisa to Lucca, and from Florence to Patro; which makes in all, 120 Italian miles, or nearly

60 leagues. The total length of the wires is 121 leagues, weghing 70,000 pounds; 2488 posts.

The expense of placing the wire which cost at first 400 pounds per mile, is reduced to 30 or 40 francs at present, that the wires are placed by the guardians of the telegraph. The telegraphic apparatus is furnished in part by M. Brequet, and part by the constructor of the University, M. Piernecci; a complete apparatus costs 600 livres.

The following is a table of necessary expense for the establishment of the Tuscan lines:—

	Livres.	Sous.
Iron Wire,	23,348	8
Posts of fir tree,	21,426	13 4
Tenders,	3,347	
Porcelain shield,	2,627	13
Wooden box,	1,772	13 4
Furniture, and supplies of the office,	8,183	18 8
Laying of copper wire, varnish,	5,314	13 4
Machines and piles,	26,043	17
Timber, cost of posts, administration, studies, and superintendance of the work,	3,443	3 4
Total,	95,507	10

Germany.

The telegraph lines of Germany have chiefly been established within the last three years. Gauss and Weber at Gottingen, and Steinhiel at Munich, had short lines of telegraph, in 1834 and 1837; but the railroad companies were the first to make a proper appreciation of them, and establish lines for their own benefit. The first great line along the railway from Mentz to Frankfort, was erected by Fardly, a mechanician of Manheim, with Wheatstone's index apparatus. It was this line that aroused the attention of the Prussian Government, and caused the appointment of a committee to experiment on the matter.

No. 781 of the London *Mining Journal* for 1850, states that 2000 miles of telegraph are already open in Germany, and that 1000 more will be added in 1851; it works now from Cracow to Trieste, a distance of 700 miles, and a general union of the Austrian, Prussian, Saxon, and Bavarian lines was soon expected, with a tariff of charges nearly as low as that of the United States.

(To be Continued.)

Explanation of Diagrams Illustrating the Action of the Forces on the Crank of a Steam Engine. By W. Pole, C. E.*

(*With a Plate.*)

[In the year 1849, the Society of Arts offered a prize "for the best collection of diagrams (with explanations,) to illustrate the action of the forces on a crank or cranks turned from a horizontal direct action steam cylinder or cylinders; the effect of various proportions of connecting rods, and degrees of expansion of steam, being shown."

The present paper was communicated to the Society in accordance with their invitation, and obtained the silver Isis medal. It is now first printed by the joint permission of the Society and the author.]

The 15 diagrams contained in plate II, illustrate the action of the forces

* From the London Journal of Arts and Sciences, April, 1852.

on one and two cranks, turned from horizontal direct action steam cylinders; the effect of various proportions of connecting rods, and degrees of expansion of steam, being shown.

The varieties of expansion taken in these diagrams, are three, viz:

Steam admitted during the whole stroke, (Nos. 4, 5, 6.)
" " half the stroke, (Nos. 7, 8, 9.)
" " one-fourth the stroke, (Nos. 10, 11, 12.)

It has not been thought necessary to exhibit a higher degree of expansion than four times; this limit being seldom exceeded in crank engines.

The varieties of length of connecting rod have also been taken at three, viz:

Connecting rod indefinitely long, (supposed to act always in parallel directions.) (Nos. 1, 4, 7, 10.)
Connecting rod five times the length of crank, which may represent about the ordinary length. (Nos. 2, 5, 8, 11.)
Connecting rod three times the length of crank, or about the shortest made. (Nos. 3, 6, 9, 12.)

Diagrams Nos. 1, 2, and 3, are explanatory of the action of the forces, in the transmission of the power from the piston to the crank, for the three varieties in the length of connecting rod respectively. AB is the piston rod, supposed to be propelled forward by a certain pressure of steam, in the direction shown by the arrow. At the joint, B, this pressure resolves into two; one in the direction, BG, (causing the friction on the guide;) the other along the connecting rod, BC; the latter force being = the pressure on piston × secant of angle, CBD. At the crank pin, C, the force acting along the connecting rod, is again resolved into two; one along the crank, CD; the other, the *tangential force*, tending to turn the crank round in the direction, CT. This tangential force is = the force acting along connecting rod × sine of angle BCD.

The object of diagrams Nos. 4 to 12, is to exhibit the values and variations of the first and last named forces; or, so to speak, the forces at the beginning and end of the engine; *i. e.*, the pressure of steam on the piston, and the force turning the crank round.

Each of these diagrams contains two figures. The left hand figure shows the pressure on the piston at all points of the stroke, on the plan of rectangular co-ordinates; the abscissa representing the space passed over by the piston, and the ordinate the corresponding pressure. Thus, when the piston has moved from 0 to x, No. 8, or $\frac{7}{10}$ths of the whole stroke, the steam pressure upon it is represented by the line, xy. The scale given under the left hand figure, in Nos. 4, 5, 6, and which also applies to Nos. 7 to 12, shows the position of the crank corresponding to any given position of the piston; thus, in No. 6, it is seen, by inspection, that when the piston has passed through $\frac{5}{10}$ths of its course, the crank has passed through about 81° from the dead point; and so on.

The right hand figure in each diagram represents the tangential or working force, acting on the crank pin, at every point of its semi-revolution from E to F, Nos. 1, 2, and 3. The curve of this figure is also laid down by rectangular co-ordinates: the path of the crank pin (reduced to a straight line,) forms the line of the abscissæ, while the ordinates express the corresponding forces. Thus, in fig. 5, when the crank pin has moved

from 0 to θ, or 120° from the dead point, the tangential force tending to turn it round, is represented by the line $\theta\rho$.

The additional scale, under this figure, shows the position of the piston corresponding to any given position of the crank; thus, in fig. 5, when the crank is at 140°, the piston has moved through $\frac{9}{10}$ths of its stroke, and so on.

The lines representing the forces are measured by a scale, which is appended to fig. 4. The pressure of the steam upon the piston, while the steam valve is open, is made = 100 on the scale; and the ratio of any other force to this pressure is therefore easily ascertained by simple measurement.

Diagrams 4, 5, and 6, show the values of the forces when the steam is admitted during the whole stroke.

In No. 4, the connecting rod is supposed indefinitely long; the pressure on the piston is uniform at 100. The tangential force on the crank pin begins at 0 when the crank is at the dead point; increases to 100 when it arrives at 90°; and diminishes again to 0, in the same ratio as the increase. The mean value of the force, throughout the semi-revolution, is = 63·6, which, × the space passed through by the crank pin, is exactly = the pressure on the piston × the length of its stroke; or, in other words, the area of the figure *efg* = the parallelogram *abcd*. This result is in accordance with the principle of "conservation of *vis viva*," by which we know that, (neglecting friction,) the amount of power or work given out at the crank pin is equal to that performed by the steam on the piston.

In No. 5 is seen the effect of the connecting rod being made five times the length of the crank. Here the tangential force commencing at 0, arrives at a maximum value of about 102 when the crank has passed through about 80°.

In No. 6, where the connecting rod is three times the length of the crank, the tangential force arrives at a maximum value of about 106 when the crank has passed through about 75°.

It will be perceived, however, that these variations make no difference in the mean force throughout the whole figure, the effect of the connecting rod being merely to vary, in a slight degree, the distribution of the force over the path of the crank pin, without affecting the total amount of power conveyed by it to the machinery. The comparative merits of long and short connecting rods in other points of view, involve considerations which it would be out of place to introduce here.

The return stroke, or the other semi-revolution of the crank, does not exactly correspond with the figures shown in diagrams, 5 and 6, owing to the reversed position of the connecting rod. The nature of the variation will be seen in fig. 6*, where the tangential force is shown for an entire revolution of the crank. It will be observed here, that the force at 10° corresponds with that at 350°, at 60° with 300°, and so on.

Nos. 7, 8, 9, show the effect of cutting off the steam at half the stroke. Here the mean pressure on the piston is = 84·6, and the mean tangential force on the crank pin is = 54,—the equality between the areas of the right and left hand figures being still preserved. The power of the engine is diminished in the proportion of 1000 : 846, although the economy is much increased, as is well known.

Nos. 10, 11, 12, show the effect of cutting off the steam at one-fourth of the stroke. Here the mean pressure on the piston is = 59·6, the mean tangential force is = 38; and the power of the engine is reduced from 100 to 59·6.

Nos. 9*, and 12*, show the values of the tangential force through an entire revolution of the crank, in the cases above alluded to under corresponding numbers.

Combined Action of two Engines, with Cranks fixed at right angles to each other.

The effect of two engines, so coupled, is shown in six cases out of the nine previously described; namely, with three variations in the degree of expansion, and two in the length of connecting rod. The curve of tangential forces is laid down for two cranks in diagrams Nos. 4, 7, 10, 6*, 9*, and 12*; in the three former, for half a revolution, (the other half being precisely similar,) and in the three latter, for a whole revolution of the crank.

It is presumed that these figures will be understood without any further description. As an example, at θ, (No. 9*,) one crank is supposed to have traveled 130° from the dead point, E, (No. 3,) the tangential force on it being expressed by the line, $\theta\rho^1$: the second crank will then have traveled 220° from the same point; and the combined tangential force will be represented by the line, $\theta\rho^2$. The undulations of the upper line will therefore represent the inequalities of the working power in the crank shaft throughout its whole revolution.

Method of Construction of the Diagrams.

In laying down the forces in these diagrams, the following points have been assumed:—

(*a*.) That, as long as the steam valve remains open, the pressure of the steam in the cylinder is uniform. This is not always the case in practice, but must generally be assumed in calculation.

(*b*.) That, after the steam valve is closed, the steam expands according to Marriotte's law, the pressure varying inversely as the volume. This is the usual assumption: the causes of variation from this law are treated of in works on the steam engine, but cannot be comprehended in an investigation of the present nature.

(*c*.) That no power is lost by friction, in the transmission of the force through the machine.

(*d*.) The influence of the clearance space on the volume of the steam, in expanding, has been neglected. This is but of small moment, and its introduction would have interfered materially with the simplicity and clearness of the diagrams.

(*e*.) The moving parts are supposed to have no weight or mass; the forces being considered in a statical point of view only.

The curves have been formed by finding the length of ordinates at convenient distances apart, and tracing a curved line through the points thus obtained.

The left hand figures in diagrams Nos. 4 to 12, representing the pres-

sures on the piston, are so simple, that the method of their construction need not be further alluded to than by stating, that the expansion curve, in figs. 7 to 12, is a hyperbola; the property of which is, that (in fig. 8,)

$$\text{As } ox : ol :: lp : xy$$

which follows from Marriotte's law.

The lengths of the ordinates in the right hand figures (the tangential forces) have been found in the following manner:—

Let Nos. 2 and 3, represent a given position of the engine. Draw the tangent, CT. Produce the line of connecting rod, BC; draw CH parallel to AD, and set off CH = the pressure on the piston at that position of the engine. Draw HJ perpendicular to CH; and from the point, J, where it cuts the line of connecting rod, draw JT, parallel to DC, cutting the tangent, CT, in T; then CJ is = the force along the connecting rod, and CT is = the tangential force on the crank pin, which is the ordinate required.

The curves in the diagrams may be expressed by algebraical equations, as follows:—

For the pressure of steam on the piston, in expanding, as shown in the left hand figures, Nos. 7 to 12. Let the pressure on the piston, while the steam valve is open, = P; and let l = length of stroke passed over before the steam valve is closed. Then, if x = any length passed over greater than l, and y = the corresponding pressure, we have, by Marriotte's law—

$$y = \mathrm{P}\frac{l}{x}.$$

For the tangential force on crank pin, as shown on the right hand figures, Nos. 4 to 12. Referring again to diagrams Nos. 2 and 3, let

r = CD, the radius of crank,
c = BC, length of connecting rod,
θ = angle CDE,
ϕ = angle CBE,
z = force acting along connecting rod,
f = tangential force required (=CT).

Then, by statical rules, we have, while the steam valve is open,

$$z = \mathrm{P}\ \mathrm{Sec}\ \phi,$$

$$\text{and } f = z\ \mathrm{Sin}\ (\mathrm{BCD});$$

whence, after making all necessary trigonometrical reductions, we arrive at the equation required:

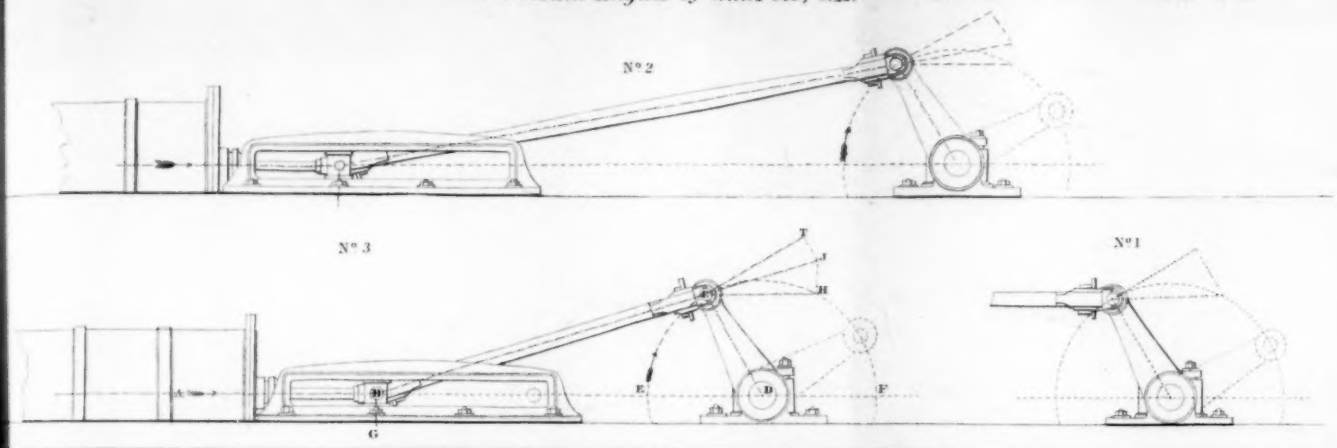
$$f = \mathrm{P}\ \mathrm{Sin}\ \theta \left\{ 1 + \frac{\mathrm{Cos}\ \theta}{\sqrt{\frac{c^2}{r^2} - \mathrm{Sin}^2\ \theta}} \right\}$$

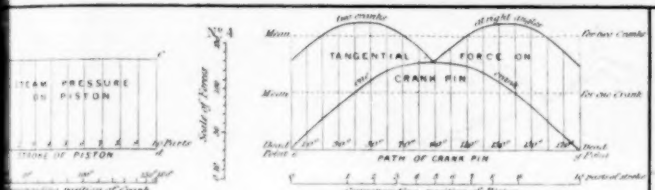
After the steam is cut off, and the pressure in the cylinder becomes variable, we have

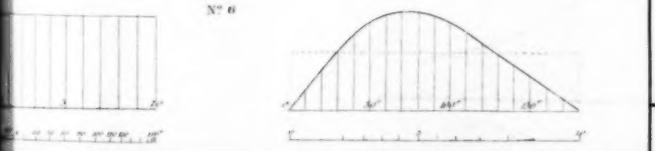
$$\text{Pressure on piston} = \mathrm{P}\frac{l}{c + r\ \mathrm{Vers}\ \theta - \sqrt{c^2 - r^2\ \mathrm{Sin}^2\ \theta}};$$

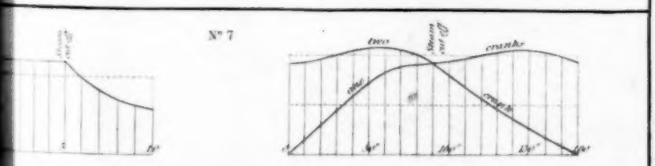
which must be substituted for P in the preceding equation.

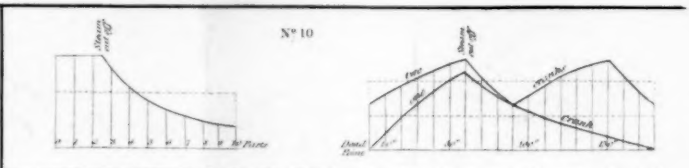
Diagrams illustrating the action of the forces on the Crank of a Steam Engine by Wm. Pole, C.E.

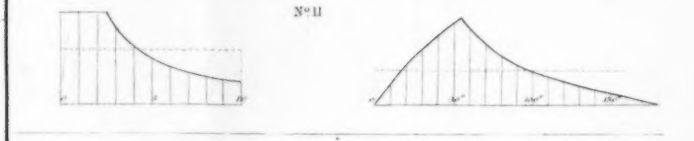


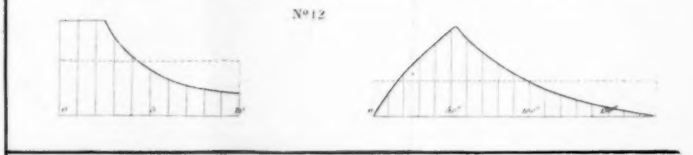


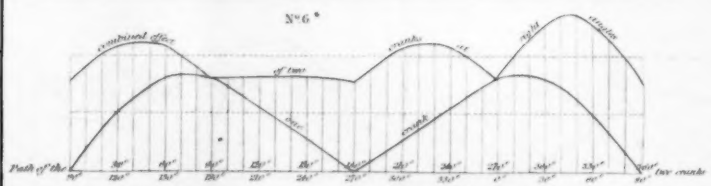












On Electro-Magnetic Clocks. By Prof. Brande.*

Mr. Brande began by adverting to the various opinions which had been entertained in reference to the mutual relations of electricity and magnetism previous to the grand discovery of Oersted, in 1819. As soon as the influence of an electrical current upon a magnetic needle had been developed by the researches of that philosopher, many important applications of the fact almost of necessity suggested themselves, amongst which the wonders of the electric telegraph were to be included. Another result of Oersted's discovery was the electro-magnet; the power, namely, of conferring by proper adjustments of an electric current any degree of magnetism upon a bar of soft iron: and inasmuch as these magnetic energies cease the moment that the electric current ceases, so we have it in our power to render any convenient form of soft iron, such as bars, or horse-shoes, powerful magnets at one moment, and at the next, entirely withdraw all their powers; and this, simply by making and breaking the contacts upon which the flow of electricity from voltaic arrangement depends. In this way a horse-shoe magnet was made alternately to lift and drop a weight, to raise and depress a loaded lever, and to bend and release a spring. These effects were merely due to the attractive force of the electro-magnet upon holders and bars of soft iron, with proper contrivances to prevent the interfering influence of the residuary magnetism which in such cases is more or less retained by the iron core of the coil. Another form of this application of electro-magnetism as a motive power consists in so arranging the electro-magnets that the poles may be alternately inverted, and so made to act upon adjacent permanent bar magnets, both attractively and repulsively. These forms of the apparatus were exhibited. Mr. Brande then stated that on examining Mr. Shepherd's electro-magnetic clocks at the Great Exhibition, he had been especially struck by the excellent illustration which they afforded of the exclusive use of electro-magnetism as their moving power, its force being employed to give impulse to the pendulum, to propel the ordinary movement of the clock, and to effect the striking of the hour; no auxiliary weights or springs being in any case employed. Thinking the whole subject worthy the attention of the members of the Royal Institution, he had applied to Mr. Shepherd for such information and assistance as he required, and Mr. Shepherd had furnished him with the pendulums, clocks, models, and diagrams then before them, and with most useful information in reference to the whole subject. Mr. Brande first explained the mechanism of the pendulum, which is so arranged as to make and break an electric circuit, and consequently to make and unmake a horse-shoe magnet at each vibration. Each time that the magnet is made it attracts its armature, which lifts certain levers; one of these is concerned in raising a weighted lever and causing it to be held up by a latch or detent; the magnet is then unmade in consequence of the pendulum breaking the circuit, and the armature is released, when the pendulum lifts the latch, and allows the weighted lever to fall, which, in falling, strikes the pendulum so as to give it an adequate impulse; then the circuit is again completed, the

* From the London Atheneum, February, 1852.

armature attracted, the levers moved, the weight raised and held up by the detent; another vibration breaks the circuit and releases the armature; the pendulum then raises the detent, the weight falls, and in falling, its arm strikes the pendulum, and gives it an impulse; and so on. But the pendulum at each vibration not only makes and breaks the electric circuit of the battery which maintains its own action, but also, and simultaneously, that of a second battery, of which the duty is to make and unmake the electro-magnets belonging exclusively to the clock or clocks which are upon this circuit. These electro-magnets act upon the extremes of one or more horizontal bar magnets, so as alternately to attract and repel their opposed poles, and which carry upon their axis the pallets, by the alternating motion of which to the right and left, the ratchet wheel is propelled onwards at the rate of a tooth each second, and the axis of this ratchet wheel carries the pinion which moves the other wheels of the clock. The circuit of the battery connected with the striking part of the clock is only completed once in an hour, and is connected with an electro-magnet so arranged as by means of a proper lever to pull the ratchet wheel attached to the notched striking wheel one tooth forward every two seconds, and each tooth is accompanied by a blow on the electro-magnetic bell. The number of blows depends upon the notched wheel, the spaces on the circumference of which are adapted to the number to be struck, and when this is complete, a lever falls into the notch, and in so doing cuts off the electric current, which is not re-established through the striking electro-magnet till the next hour, when a peg upon the hour wheel pushes the striking lever forward so as to cause it to be depressed by a similar peg upon the minute wheel. A very large working model of the clock and of the striking apparatus, constructed for the occasion by Mr. Shepherd, was exhibited, as well as a model of the pendulum and its appendages made under the direction of Mr. C. V. Walter, to whom Mr. Brande was also indebted for a signal bell, on the principle of Mr. Shepherd's clock bells, for the purpose of giving notice to the railway switchmen of the approach of trains in foggy weather.

Contributions to the Physiology of Vision.—Part II.—On some Remarkable, and hitherto unobserved, Phenomena of Binocular Vision. A Bakerian Lecture, delivered by CHARLES WHEATSTONE, ESQ., F. R. S.*

The first part of these researches was communicated to the Royal Society in 1838, and published in the Philosophical Transactions for that year.

The second part, now presented, commences with an account of some remarkable illusions which occur when the usual relations which subsist between the magnitude of the pictures on the retinæ and the degree of inclination of the optic axes are disturbed. Under the ordinary circumstances of vision, when an object changes its distance from the observer, the magnitude of the pictures on the retinæ increases at the same time that the inclination of the optic axes becomes greater, and *vice versa*, and the perceived magnitude of the object remains the same. The author

* From the London, Edinburgh, and Dublin Philos. Mag., Feb., 1852.

wished to ascertain what would take place by causing the optic axes to assume every degree of convergence while the magnitude of the pictures on the retinæ remains the same; and, on the other hand, the phenomena which would be exhibited by maintaining the inclination of the optic axes constant while the magnitude of the pictures on the retinæ continually changes. To effect these purposes, he constructed a modification of his reflecting stereoscope; in this instrument two similar pictures are placed, on movable arms, each opposite its respective mirror; these arms move round a common centre in such manner that, however they are placed, the reflected images of each picture in the mirror remains constantly at the same distance from the eye by which it is viewed; the pictures are also capable of sliding along these arms, so that they may be simultaneously brought nearer to, or removed further from, the mirrors. When the pictures remain at the same distance and the arms are removed round their centre, the reflected images, while their distances from the eyes remain unchanged, are displaced, so that a different inclination of the optic axes is required to cause them to coincide. When the arms remain in the same positions and the pictures are brought simultaneously nearer the mirrors, the reflected images are not displaced, and they always coincide with the same convergence of the optic axes; but the magnitude of the pictures on the retinæ becomes greater as the pictures approach. The experimental results afforded by this apparatus, so far as regards the perception of magnitude, are the following: the pictures being placed at such distances, and the arms moved to such positions, that the binocular image appears of its natural magnitude and its proper distance, on the arms being moved so as to occasion the optic axes to converge less, the image appears larger, and on their being moved so as to cause the optic axes to converge more, the image appears less; thus, while the magnitude of the pictures on the retinæ remains constantly the same, the perceived magnitude of the object varies, through a very considerable range, with every degree of the convergence of the optic axes. The pictures and arms being again placed so that the magnitude and distance of the object appear the same as usual, and the arms being fixed so that the convergence of the optic axes does not change; while the pictures are brought nearer the mirrors the perceived magnitude of the object increases, and it decreases when they are removed further off; thus, while the inclination of the optic axes remains constant, the perceived magnitude of the object varies with every change in the magnitude of the pictures on the retinæ. After this, the author takes into consideration the disturbances produced in our perception of distance under the same circumstances, and concludes that the facts thus experimentally ascertained regarding the perceptions of magnitude and distance, render necessary some modification in the prevalent theory regarding them.

The author next reverts to the stereoscope and its effects. He recommends the original reflecting stereoscope as the most efficient instrument, not only for investigating the phenomena of binocular vision, but also for exhibiting the greatest variety of stereoscopic effects, as it admits of every required adjustment, and pictures of any size may be placed in it. A very portable form of this instrument is then described, and also a refracting stereoscope suited for daguerreotypes and small pictures not much exceeding the width between the eyes. In the latter instrument the pictures

are placed side by side, and viewed through two refracting prisms of small angle, which displace the pictures laterally, that on the right side towards the left, and that on the left side towards the right, so that they appear to occupy the same place. When the first part of these investigations was published the photographic art was unknown, and the illustrations of the stereoscope were confined to outline and shaded perspective drawings; when, however, in the succeeding year, Talbot and Daguerre made their processes known, Mr. Wheatstone was enabled to obtain binocular talbotypes and daguerreotypes of statues, buildings, and even portraits of living persons; which, when presented in the stereoscope, no longer appeared as pictures, but as solid models of the objects from which they were taken. This application was first announced in 1841.

The two projections of an object, seen by the two eyes, are different according to the distance at which it is viewed; they become less dissimilar as that distance is greater, and, consequently, as the convergence of the optic axes becomes less. To a particular distance belongs a specific dissimilarity between the two pictures, and it is a point of interest to determine what would take place on viewing a pair of stereoscopic pictures with a different inclination of the optic axes than that for which they were intended. The result of this inquiry is, that if a pair of very dissimilar pictures is seen when the optic axes are nearly parallel, the distances between the near and remote points of the object appear exaggerated; and if, on the other hand, a pair of pictures slightly dissimilar is seen when the optic axes converge very much, the appearance is that of a bas-relief. As no disagreeable or obviously incongruous effect is produced when two pictures, intended for a nearer convergence of the optic axes, are seen when the eyes are parallel or nearly so, we are able to avail ourselves of the means of augmenting the perceived magnitude of the binocular image mentioned at the commencement of this abstract. For this purpose the pictures, placed near the eyes, are caused to coincide when the optic axes are nearly parallel; and the diverging rays proceeding from the near pictures are rendered parallel by lenses of short focal distance placed before the mirrors or prisms of the stereoscope.

Some additional observations were next brought forward respecting those stereoscopic phenomena which the author, in his first memoir, called "conversions of relief." They may be produced in three different ways: 1st, by transposing the pictures from one eye to the other; 2d, by reflecting each picture separately, without transposition; and 3d, by inverting the pictures to each eye separately. The converse figure differs from the normal figure in this circumstance, that those points which appear most distant in the latter, are the nearest in the former, and *vice versa*.

An account is then given of the construction and effects of an instrument for producing the conversion of the relief of any solid object to which it is directed. As this instrument conveys to the mind false perceptions of all external objects, the author calls it a Pseudoscope. It consists of two reflecting prisms, placed in a frame, with adjustments, so that, when applied to the eyes, each eye may separately see the reflected image of the projection which usually falls on that eye. This is not the case when the reflection of an object is seen in a mirror; for then, not only are the projections separately reflected, but they are also transposed from one eye to the other, and therefore the conversion of relief does not

take place. The pseudoscope being directed to an object, and adjusted so that the object shall appear of its proper size and at its usual distance, the distances of all other objects are inverted; all nearer objects appear more distant, and all more distant objects nearer. The conversion of relief of an object consists in the transposition of the distances of the points which compose it. With the pseudoscope we have a glance, as it were, into another visible world, in which external objects and our internal perceptions have no longer their habitual relations with each other. Among the remarkable illusions it occasions, the following were mentioned. The inside of a tea cup appears a solid convex body; the effect is more striking if there are painted figures within the cup. A china vase, ornamented with colored flowers in relief, appears to be a vertical section of the interior of the vase, with painted hollow impressions of the flowers. A small terrestrial globe appears a concave hemisphere; when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface has a very singular effect. A bust regarded in front becomes a deep hollow mask; when regarded *en profile*, the appearance is equally striking. A framed picture, hung against a wall, appears as if imbedded in a cavity made in the wall. An object placed before the wall of a room appears behind the wall, and as if an aperture of the proper dimensions had been made to allow it to be seen; if the object be illuminated by a candle, its shadow appears as far before the object as it actually is behind it.

The communication concludes with a variety of details relating to the conditions on which these phenomena depend, and with a description of some other methods of producing the pseudoscopic appearances.

On a Method of Obtaining a Perfect Vacuum in the Receiver of an Air Pump. By Thomas Andrews, M. D.*

By using the necessary precautions, a vacuum may be obtained by the following process, with very little trouble, in the ordinary receiver of an air pump, so perfect that the residual air exerts no appreciable elastic force. Even after this limit has been reached, the exhaustion may be pushed still further, till it must become at last not less complete than the Torricellian vacuum; while at the same time, by suppressing the manometer, the existence of mercurial vapor may be altogether prevented. The manipulations required to arrive at this result will not interfere with the presence of the most delicate instruments in the receiver.

Into the receiver of an ordinary air pump, which is not required to exhaust further than to 0·3 inch, or even 0·5 inch, but which must retain the exhaustion perfectly for any length of time, two open vessels are introduced, one of which may be conveniently placed above the other; the lower vessel containing concentrated sulphuric acid, the upper a thin layer of a solution of caustic potash, which has been recently concentrated by ebullition. The precise quantities of these liquids is not a matter of importance, provided they are so adjusted that the acid is capable of desiccating completely the potash solution without becoming itself notably diminished in strength, but at the same time does not expose so

* From the London, Edinburgh, and Dublin Philosophical Magazine, February, 1852.

large a surface as to convert the potash into a dry mass in less than five or six hours at the least. The pump is in the first place worked till the air in the receiver has an elastic force of 0·3 or 0·4 inch, and the stop-cock below the plate is then closed. A communication is now established between the tube for admitting air below the valves and a gas-holder containing carbonic acid, which has been carefully prepared so as to exclude the presence of atmospheric air. After all the air has been completely removed from the connecting tubes by alternately exhausting and admitting carbonic acid, the stop-cock below the plate is opened and the carbonic acid allowed to pass into the receiver. The exhaustion is again quickly performed to about the extent of half an inch or less. If a very perfect vacuum is desired, this operation may be again repeated; and if extreme accuracy is required, it may be performed a third time. It is not likely that any thing could be gained by carrying the process further. On leaving the apparatus to itself, the carbonic acid which has displaced the residual air is absorbed by the alkaline solution, and the aqueous vapor is afterwards removed by sulphuric acid. The vacuum thus obtained is so perfect, that even after two operations it exercises no appreciable tension.

To give a clear conception of the progress of the absorption, I will describe in detail one observation in which the tension was measured simultaneously by a good syphon-gauge and by a manometer, formed of a barometric tube 0·5 inch in diameter, inverted in the same reservoir of mercury as a similar tube communicating with the interior of the receiver. The barometer had been carefully filled, and the depression of the mercury estimated by the method already described at less than $\frac{1}{1000}$dth of an inch.

Previous to the admission of the carbonic acid, the exhaustion was carried only to 0·4 inch; it was again carried to 1 inch; and a third time to 0·5 inch, after which the apparatus was left to itself. The manometer indicated a pressure in—

15′ of 0·25 inch.
30′ " 0·17 "
80′ " 0·10 "
200′ " 0·02 "

In twelve hours the difference of level was just perceptible, when a perfectly level surface was brought down behind the tubes till the light was just excluded. In thirty-six hours not the slightest difference of level could be detected. The vacuum has remained without the slightest change for fourteen days.

It is evident that the only limit to the completeness of the vacuum obtained by this process, arises from the difficulty of preparing carbonic acid gas perfectly free from air. This may be very nearly overcome by adopting precautions which are well known to practical chemists. When an extreme exhaustion is required, the gas-holder should be filled with recently boiled water, and the first portions of carbonic acid that are collected in it should be allowed to escape.

The substitution of phosphoric for sulphuric acid would remove the possibility of either aqueous or acid vapors being present even in the smallest amount, but such a refinement will rarely be found necessary.

In the experiment just described, the theoretical residue of air would be $\frac{1}{135.000}$dth part of the entire quantity in the receiver, which would cause a depression of $\frac{1}{15.000}$dth of an inch. This result must have been nearly realized. If the exhaustion had been carried at each time to 0·2 inch, the residue by theory would have been only $\frac{1}{3·375.000}$dth part. But the experimental results will not continue to keep pace with such small magnitudes.

Queen's College, Belfast, January 7, 1851.

Chemical Report on the Cause of the Fire in the Amazon. By Professor Graham.*

In reply to the questions arising out of the disastrous loss of the *Amazon* by fire, which are proposed to me for a Chemical opinion, I beg to submit to your Lordships the following statements and conclusions:

The practice of mixing together the various stores of the engineer, consisting of oils, tallow, soft-soap, turpentine, cotton waste, and tow, and placing them in heated store-rooms contiguous to the boilers, must be looked upon as dangerous in no ordinary degree, for several reasons. Although oil in bulk is not easily ignited, particularly when preserved in iron tanks, still, when spilt upon wood, or imbibed by tow and cotton waste, which expose much surface to air, the oil often oxidates and heats spontaneously, and is allowed to be one of the most frequent causes of accidental fires. The vegetable and drying oils used by painters are most liable to spontaneous ignition; but no kind of animal or vegetable oil or grease appears to be exempted from it; and instances could be given of olive oil igniting upon sawdust; of greasy rags from butter, heaped together, taking fire within a period of twenty-four hours; of the spontaneous combustion of tape-measures, which are covered with an oil varnish, when heaped together; and even of an oil-skin umbrella put aside in a damp state. The ignition of such materials has been often observed to be greatly favored by a slight warmth, such as the heat of the sun. I am also informed by Mr. Braidwood, that the great proportion of fires at railway stations have originated in the lamp store, and that in coach works also, when the fire can be traced, it is most frequently to the painter's department, the fire having arisen spontaneously from the ignition of oily matters. Lamp-black and ground charcoal are still more inflammable, when the smallest quantity of oil obtains access to them, and should not be admitted at all among ships' stores.

The stowing metallic cans or stoneware jars of either oil or turpentine in a warm place is also attended with a danger which is less obvious, namely, the starting of the corks of the vessels, or the actual bursting of them by the great expansion of the liquid oil which is caused by heat. These liquids expand in volume so much as one upon thirty by a rise of not more than 60° of temperature, or by such a change as from the ordinary low temperature of 40° to a blood-heat; the latter temperature may easily be exceeded in an engine room. It is remarkable that the burning a few years ago of a large steamer on the American lakes, which

* From the Journal of the London Chemical Society, April, 1852.

even surpassed in its fatality the loss of the *Amazon*, was occasioned by the bursting, in the manner described, of a jar of turpentine placed upon deck too close to the funnel, by a party of journeymen painters who were passengers. This steamer was also on her first voyage, and being newly varnished, the flames spread over her bulwarks and extended the whole length of the vessel in a few minutes.

The bulkheads of coal-holds appear to admit of obtaining considerable security from fire, by being constructed double where close to the boiler, with a sheet of air between the two partitions. The tendency of coals to spontaneous ignition is increased by a moderate heat, such as that of the engine room, from which they would be protected by the double partition. I have obtained instances where coals took fire in a factory, on two different occasions, by being heaped for a length of time against a heated wall, of which the temperature could be supported by the hand; also of coals igniting after some days upon stone flags covering a flue, of which the temperature was not known to rise above 150°, and of coals showing indications of taking fire by being thrown in bulk over a steam pipe. These were Lancashire coals, which are highly sulphurous; but the same accident occurred with Wallsend coals, at the Chartered East Company's works in London, where the coals were twice ignited through a two-feet brick wall, of which the temperature was believed by Mr. Croll not to exceed 120° or 140°.

The surface of deal in the partition opposed to the boiler would probably be better protected from fire by impregnating the wood with a saline solution, which diminishes combustibility, such as the zinc solution of Sir W. Burnett, rather than by coating the wood on the side next the boiler with sheet iron. Indeed, this use of iron appears to introduce a new danger. The iron being a good conductor of heat, the wood below is heated nearly as much as if uncovered, and wood in contact with iron appears to be brought by repeated heating to an extraordinary degree of combustibility, and to become peculiarly liable to spontaneous ignition.

Mr. Braidwood, who has been led to that conclusion, gave an instance of wood covered by sheet iron igniting spontaneously in a wadding manufactory. The numerous occasions, also, on which wood and paper have been ignited by Perkins' heated water pipes, equally exemplify the dangerous consequences which may arise from moderately heated iron in long contact with combustible matter.

The most obvious precautions for guarding against the spontaneous ignition of coal stowed in ships' bunkers, appear to be the taking the coal on board in as dry a condition as possible, and the turning it over, if there is room for doing so, as soon as the first symptom of heating is perceived. An obnoxious vapor is described as always preceding the breaking out of the fire, and affords warning of the danger. The ignition of Newcastle coals in store is not an unfrequent occurrence at the London gas works. It appears always to begin at a single spot, and is met by cutting down upon and removing at once the heated coals. Long iron rods are placed upright in the coal heap, which can be pulled out, and indicate by their warmth the exact situation of the fire. Steam can be of little avail for extinguishing fire among coals in bulk; and water, although

it may extinguish the fire for the time, is too apt to induce a recurrence of the evil.

For extinguishing a fire occurring in berths or cabins in the immediate vicinity of the boiler and engine room, steam might be more advantageously applied, means of turning on the steam being provided upon the upper deck, or other distant place of safety. Steam, however, can only be said to be efficient in extinguishing flame, or a blaze from light objects, and is not to be relied upon beyond an early stage of a fire. Upon a mass of red-hot cinders, the extinguishing effect of steam is insensible.

An essential condition of applying steam with success to the extinction of a fire in the engine room, would be to prevent the rapid ingress and circulation of air at the same time, which is occasioned by the draught of the fires. This could only be done completely by valving the chimnies; for the quantity of heated air passing off by the funnels greatly exceeds in volume the steam produced by the boilers in the same time, and would rapidly convey away the steam thrown into the atmosphere of the engine room, and prevent any possible advantage from it.

The fire in the *Amazon* appeared to the witnesses to take its rise either in the small oil store room situated over the boiler, or in a narrow space of from three to eleven inches in width, between a bulkhead and the side of the boiler, immediately under the same store room. No substance remarkable for spontaneous ignition, such as oiled cotton waste, was actually observed in the store room or the space referred to. The wood itself of the bulkhead, which was within a few inches of the boiler, may have been highly dried and sensibly heated by its proximity to the latter, but is not likely to have acquired any tendency to spontaneous ignition; for when that property results from low heating, it is an effect of time, requiring weeks or months to develope it. The same observation applies to the decks in contact with the steam-chest which incased the base of the funnel.

Nor does it appear probable that the coals in the coal-hold of the vessel gave occasion to the fire by heating of themselves, and then burning through the wooden partition of the oil store with which they were in contact.

These coals were from Wales, and not remarkable for this property.

They are also said to have been shipped in a dry and dusty state, and not damp, a month or two previously.

Their ignition would also have been preceded by the strong odor before referred to, which does not appear to have been remarked, although the coal-hold communicated directly with the boiler room.

Oil was seen to drop from the floor of the store room upon the top of the boiler, but not in greater quantity than might be accidentally spilt in drawing the oil from the tank for the use of the engineers.

A parcel of twenty-five newly tarred coal-sacks, which had been thrown upon the boiler, also obtained, it is supposed, some of the same oil. This oil appears to be the matter most liable to the possibility of spontaneous ignition, which was noticed near the spot where the fire commenced.

But the sudden and powerful burst of flame from the store room, which

occurred at the very outset of the conflagration, suggests strongly the intervention of a *volatile* combustible, such as turpentine, although the presence of a tin can of that substance in the store room appears to be left uncertain. It was stated to be there by two witnesses, but its presence is denied by a third witness. I find upon trial, that the vapor given off by oil of turpentine is sufficiently dense, at a temperature somewhat below 110°, to make air explosive upon the approach of a light. Any escape of turpentine from the heated store room would therefore endanger a spread of flame, by the vapor communicating with the lamps burning at the time in the boiler room, or even with the fire of the furnaces.

The fire appears not to have begun in the tarred sacks lying upon the boiler, although from their position, which was close to the store room, they must have been very early involved in the conflagration, and contributed materially to its intensity. The sacks appear to have been charged each with about two pounds of tar, thus furnishing together fifty pounds of that substance, in a condition the most favorable that can be imagined for rapid combustion. The freshness of the tar and its high temperature would make it ignite by the least spark of flame, although not prone to spontaneous ignition. The burning of a group of newly tarred cottages in Deptford, which came under the notice of Mr. Braidwood, arose from their being set on fire by lightning, while the sun was shining upon them, and the tar liquefied by the heat.

The origin of the fire must remain, I believe, a subject of speculation and conjecture; but the extreme intensity and fearfully rapid spread of the combustion, are circumstances of scarcely inferior interest, which are not involved in the same obscurity.

The timber of the bulkheads and decks near the engine room is reported to have been of Dantzic red wood, or Riga pine, and such was the character of a portion of the *Amazon's* timber which was supplied to me for chemical examination. The wood has had its turpentine drawn off, and differs in that respect from pitch pine. The Dantzic red wood is, in consequence, less combustible than pitch pine, but more porous and spongy. Oil-paint is absorbed, and dries more quickly upon this porous wood than upon oak and other dense woods. After their paint is well dried, pine and other woods certainly acquire from it some protection from the action of feeble and transient flames, which might kindle the naked wood. But the effect of paint, especially of fresh paint, appears to be quite the reverse, when the wood is exposed to a strong although merely passing burst of flame. The paint melts and emits an oily vapor, which nourishes the flame, and soon fixes it upon the wood. There can be no doubt, therefore, that the timber of the *Amazon* was in a more inflammable state than ship timber usually is, from being recently painted, and also probably from its newness and comparative dryness.

But the circumstance which appears above all others to give a character to the fire in the *Amazon* was its occurrence, not in a close hold or cabin, but in a compartment of the vessel where a vigorous circulation of air is maintained by the action of the boiler fires and their chimnies. The air of the engine room must be renewed under this influence every few minutes, and would be so although full of flames rising above deck through the hatchways; for a portion of these flames would always escape

by the funnels, and add to their aspirating power instead of diminishing it. The combustion of bulkheads or decks once commenced in this situation would therefore be fanned into activity and powerfully supported.

The destruction of the floor of the oil store room, and the overturning, in consequence, of the oil tanks and combustibles into the well of the boiler room, was probably the crisis of the fire. A mass of combustible vapor would speedily be generated, and shot about on all sides, of which the kindling power upon the new and painted timber of the bulkheads and decks would be wholly irresistible.

The burning of the *Amazon* impresses most emphatically the dangerous and uncontrollable character of a fire arising in the engine or boiler room, where the combustion is animated by a steady and powerful circulation of air, and the danger of collecting combustible matter together in such a place. The removal of the oil stores to a safer locality is, fortunately, generally practicable, and is the measure best calculated to prevent the recurrence of any similar catastrophe.—*Feb.* 17, 1852.

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*Silesian Iron.**

From notice in the *Times* of the Silesian Exhibition of Arts and Manufactures.

The most extensive display of iron, in all the stages of its manufacture, is sent from the numerous forges or *Hutten* of Count Renard, who alone occupies a large portion of the basement of the building. The quality of the metal produced at his works has secured it a local reputation, though other establishments, as the Laura Works, at Beuthen, produce iron in bar and the larger forms in greater quantity. The Renard Works are unrivalled in the finer sorts, and of hoop iron, nail-rods, wire, cast iron for cooking vessels, steel in many varieties, especially forged steel of the finest quality, there is a most abundant supply. Sheet iron is exhibited from these works of such a degree of tenuity that the leaves can be used for paper. A bookbinder of Breslau has made an album of nothing else, the pages of which turn as flexibly as the finest fabric of linen rags. As yet no extensive application for this form of the metal has been found, but the manager says the material must precede the use for it; perhaps books may hereafter be printed for the tropics on these metallic leaves, and defy the destructive power of ants of any color or strength of forceps. We have only to invent a white ink, and the thing is done. Of the finest sort, the machinery rolls 7040 square feet of what may be called leaf iron from a cwt. of metal. In point of price, however, the Silesian iron cannot compete with English; much is still smelted with wood, and the coal and iron districts lie at great distances from each, so that much capital is consumed by the conveyance of fuel to the works.

* From the London Mechanics' Magazine, June, 1852.

Mixtures for Colored Fires. By Prof. MARCHAND.*

The following recipes for the preparation of mixtures for colored fires were found among the posthumous papers of the late Prof. Marchand. The materials are rubbed to a fine powder separately, and then mixed with the hand:—

Red.

61 p. c. chlorate of potash.
16 sulphur.
23 carbonate of strontia.

Purple-red.

61 p. c. chlorate of potash.
16 sulphur.
23 chalk.

Rose-red.

61 p. c. chlorate of potash.
16 sulphur.
23 chloride of calcium.

Orange-red.

52 p. c. chlorate of potash.
14 sulphur.
34 chalk.

Yellow.

61 p. c. chlorate of potash.
16 sulphur.
23 dry soda.

or,

50 p. c. nitre.
16 sulphur.
20 soda.
14 gunpowder.

or,

61 p. c. nitre.
17½ sulphur.
20 soda.
1½ charcoal.

Light Blue.

61 p. c. chlorate of potash.
16 sulphur.
23 strongly-calcined alum.

Dark Blue.

60 p. c. chlorate of potash.
16 sulphur.
12 carbonate of copper.
12 alum.

Dark Violet.

60 p. c. chlorate of potash.
16 sulphur.
12 carbonate of potash.
12 alum.

Pale Violet.

54 p. c. chlorate of potash.
14 sulphur.
16 carbonate of potash.
16 alum.

Green.

73 p. c. chlorate of potash.
17 sulphur.
10 boracic acid.

Light Green.

60 p. c. chlorate of potash.
16 sulphur.
24 carbonate of baryta.

FOR THEATRICAL ILLUMINATION.

White.

64 p. c. nitre.
21 sulphur.
15 gunpowder.

or,

76 p. c. nitre.
22 sulphur.
2 charcoal.

Red.

56 p. c. nitrate of strontian.
24 sulphur.
20 chlorate of potash.

Green.

60 p. c. nitrate of baryta.
22 sulphur.
18 chlorate of potash.

Pink.

20 p. c. sulphur.
32 nitre.
27 chlorate of potash.
20 chalk.
1 charcoal.

Blue.

27 p. c. nitre.
28 chlorate of potash.
15 sulphur.
15 sulphate of potash.
15 ammonio-sulphate of copper.

*From the London Chemical Gazette, May, 1852.

The dark blue is rendered still darker by the addition of some sulphate of potash and ammonio-sulphate of copper.—*Journ. für Prakt. Chem.*, lv. p. 250.

For the Journal of the Franklin Institute.

Steamboats on the Western Waters. By SAMUEL H. GILMAN, Esq.

To the Committee on Publications.

GENTLEMEN:—My attention has recently been directed to an article in the May number of your *Journal*, "On the Steamboats of the Western Waters of the United States," containing statements, as manifestly unjust to the character of the enterprising spirit and mechanical skill of the West, as developed in its steam navigation, as the writer was manifestly unacquainted with the past and present history of steam navigation on Lake Erie, the river Mississippi, and its tributaries.

If the fact that a peculiar class of steam vessels, existing in one section of our country, having failed to compete successfully with another class, entirely different in their construction, and existing only in another and distant section, is evidence of "a spirit of prejudice and servile imitation," having produced such a failure, then the engineers of the Atlantic cities are the prejudiced and servile imitators, as the history of steam navigation in the West will abundantly show.

During a long period after steam vessels were introduced into the waters of the Western lakes and rivers, low pressure engines were universally used, with a few trifling exceptions; and in 1825, there was but one high pressure steamboat on Lake Erie, where they now constitute the majority; and there is not a single low pressure steamboat now on the Mississippi, or its tributaries, with the exception of three tow boats below New Orleans. Most of the improvements that have been from time to time adopted on the Hudson and other Northern rivers, up to the present day, have proved failures when transferred to the West; steamboats that were among the most successful on the Hudson, when transferred to the Mississippi, were complete failures, in competition with its high pressure boats. The experiment has often been made, and always with the same results; and boats built in New York, expressly for that purpose, were equally unsuccessful; and a multiplicity of ruinous experiments in building boats in the West on improved plans, successfully adopted elsewhere, have resulted in the present high pressure steamboat in general use on the Western rivers.

Such are the existing facts; and the intelligent observer, who is conversant with the elements which compose Western steam navigation, will not look upon the present high pressure steamboat of the West, as a product of ignorance, prejudice, or servile imitation. There are three principal elements which have combined to produce the present Mississippi steamer, and render it far superior, in its own waters, to the more staunch, elegant, safe, and speedy steamers of the Hudson river, viz: first, the character of the rivers: second, the materials of which boats are constructed; third, the traffic which supports them.

The rivers, especially all the lower ones, flowing through a delta of soft,

alluvial deposit, are exceedingly tortuous, and constantly changing their channels, by cutting away on one side, and leaving sand flats and bars on the other, and in the place of their former channels; the average velocity of the current was found to be (by the late U. S. Coast Survey, Doc. 20, 1st. Session, 32d Congress,) five miles an hour; and the narrowest places where snags most frequently are encountered, the velocity of the current is seven miles an hour. During the best part of the business season, the rivers are filled with drift wood, composed often of whole trees of the largest class, with all their roots and branches attached; immense flat boats, rafts of logs and lumber, and floating ice, are also among the obstructions; it frequently occurs that a boat, in the tortuosity of its course through these obstructions, is taken by the current and swung on to a sand bar; and during the process of sparring off, the water becomes filled with sand, which, in the use of condensing engines, choked the air pump and condenser to such an extent as to form one of the reasons why they were abandoned. The entire absence of wharves, or regular landing places, renders it necessary to keep the outer wheel in motion, to hold the boat to the shore, while receiving or discharging freight; and when on a downward trip, the swift current obliges the boat to "round to," in landing, which in many places would be impossible with a single engine.

Secondly, the best materials for constructing boats, are of such a nature that it is seldom that a boat is run more than four seasons; the dry rot, and frequent grounding at low water, with the heavy loads carried, break them down; hence, the unfinished and temporary appearance of the cabins, which being always on the upper deck, are palaces in size and comfort, but without the elegant and durable finish of northern and eastern steam vessels.

Thirdly, the traffic that supports them, is almost wholly of a merchandise character, and demands a largely preponderating capacity for freight; the cabin being more an accommodation to travelers than a source of profit to the owners. The shoal water demanding a light draft, with a heavy freight, the flat bottom follows, and superior models for speed are prohibited, with the exceptions of a few short routes between large cities, where the passenger traffic alone has been found remunerative, and where condensing engines might be used successfully during high water. It will therefore readily be seen that, in a boat depending upon a merchandise traffic, any excessive weight, or room occupied by machinery, is a constantly accumulating loss, unless met by a corresponding gain in the saving of fuel, from which is to be deducted the difference in the price of condensing and non-condensing engines. The following examples, although not as similar in some respects as could be wished, will show the approximative relative sums of loss and gain, in the use of condensing engines, for a Mississippi freight boat:

The *Magnolia*, described in McAlpine's Report, is propelled by two slightly inclined engines, mounted upon timbers, and which weigh, including the wood in the engines and wheels, boilers, and water, 256,000 pounds; when running between New Orleans and Louisville, she makes two trips a month, or sixteen trips in eight months, the usual season of high water. The *South America*, on the Hudson, has one beam engine, of about the same power as the two of the *Magnolia*, which weighs, in-

cluding timber in engines and wheels, boilers and water, 356,000 pounds, or 100,000 pounds more than the *Magnolia's* two. The average price of freight from New Orleans to Louisville, being 40 cts. per hundred pounds, the 100,000 pounds extra weight of the condensing engine will be a loss in sixteen round trips of 1000×·40=400·00×2=800·00×16=$12,800; to which is to be added $1500 per annum for extra cost of the condensing engine=$14,300 loss by excessive weight of condensing engine per annum; the average cost of the *Magnolia* for fuel per round trip is $1500 ×16=$24,000; suppose that 30 per cent. were saved by the use of the condensing engine, we should have, at the close of the season of sixteen round trips, 30 per cent. on $24,000=$7200 saved, and $14,300 lost, or a nett loss of $14,300—7200=$7100 by the use of the condensing engines. But the actual loss would be much greater, as will be seen by an inspection of the cost for fuel, of carrying one ton one mile in the respective boats, the gain of speed in the *South America* being more than lost by the loss in fuel and freight capacity.

The *Magnolia* carries 1000 tons of freight from New Orleans to Louisville in six days, distance, 1465 miles, against a five mile current; 144 hours × 5 = 720 + 1460 = 2180 miles ÷ 144 hours = 15·13 miles an hour, average time; burning 70 cords of wood every twenty-four hours, when running up stream, and 40 cords when running down. According to *Bartol's Marine Boilers*, the *Magnolia* is, all things equally compared, a much more economical boat in fuel than boats using condensing engines generally are. I know this is a startling assertion, yet nevertheless true, according to all known data; but why it is so, is not a part of my intentions to discuss in this paper.

The slightly inclined engines, mounted on timbers, are adopted, because of their lightness, cheapness, and compactness; occupying but six feet on each extreme side of the deck, they leave the cabin entirely unbroken, and the centre of the deck is vacant for the passage or stowage of freight; the boilers being entirely forward of the engines; the valves are worked by cams, which give them their entire movement, either opening or closing during one-eighth of the revolution of the main shaft. They are not only allowed to lift high enough to give an area equal to their own, but they are forced to do it; and they are larger in area than the "usual English or our own Eastern practice." The rule given on page 85 of the *Treatise by the Artizan Club*, 3d edition, calls for an area of 23,758 square inches for a cylinder of 30 inches diameter by 10 feet stroke, making 15 revolutions per minute, with a boiler pressure of 125 pounds per square inch; and Haswell's 5th edition, page 213, calls for an area of 44,750 for the same size engine, number of revolutions, and pressure. The *Magnolia's* valves have an area of 56,745 square inches, and the boats described by McAlpine have an area of steam and exhaust valve generally, if not universally, larger than the "usual English or Eastern practice."

The great difference between boiler and cylinder pressure, as shown by your able Collaborator, does not exist to any thing like the extent that he has shown. There may be contractions in the steam pipes to some extent, but none of the engines from which he dated make the number of revolutions as stated; neither do they carry the pressure of

steam in the boilers. All the Pittsburg packets pass my window every trip, during several months of the year, and I frequently note their number of revolutions per minute. I have traveled several thousand miles on the *Magnolia*, and made frequent observations of the speed of her engines, and they average 14 revolutions when going up stream, and but 10 when going down; and their usual working pressure is 100 pounds per square inch by steam gauge; with the boat light, and burning pitch wood, by extraordinary exertions of the firemen, 15 revolutions have been made per minute, with 140 pounds per square inch boiler pressure. But few of the boats have steam gauges; they state the pressure to which the valve is loaded; the actual working pressure being a mere conjecture.

The great necessity of a competent, disinterested, superintending authority, in the management of the propelling power of our boats, every traveler on our rivers fully appreciates: but that it may be exercised through the medium of condensing engines, is what no man conversant with the existing elements can look for. The experience of from twenty to thirty-five years, of some engineers and companies, with high pressure boats, and without accident to their boilers, has established the impression, if not the fact, that with equal restrictions and ability in management, they are equally as safe as the low pressure or condensing engine boats.

Baton Rouge, Louisiana, August 2d, 1852.

Remarks.—We are very glad to hear from our correspondent in defence of the Western Boats; the subject being one which interests every one in our country, and the number of explosions and other fearful accidents with these boats appearing to be largely on the increase: although in view of the late most deplorable and disgraceful sacrifice of the Henry Clay's passengers on the Hudson river, we had better not for the present call the Western kettle, black-face. In the temporary absence from the country, of the gentleman whose remarks have called forth this reply, we will not take issue with Mr. Gilman, in matters which we look upon as of secondary importance, but will call his attention to the point of Mr. Merrick's remarks, which more particularly attracted our notice when the article was published. It is in reference to the extraordinary difference of pressures between the boiler and cylinder. Now what is Mr. M.'s position? He finds in the report of Mr. McAlpine, certain data in reference to the dimensions of the boats and engines of the Mississippi, the pressure of steam which they usually carry, their consumption of fuel, and their speed. Let us observe that this report of Mr. McAlpine is not a mere newspaper article, by one connected with one side or the other, nor even a mere contribution to practical science; but it is the report of a sworn Commissioner, selected from the whole United States for the purpose, to the highest judicial tribunal in our land, and intended to inform and advise that Court in the matter of a suit of no small importance. From such data, then, (which it would seem, ought to secure confidence, if confidence can be given to any statement,) Mr. Merrick proceeded in a manner which is perfectly correct, to calculate the *average working* pressure in the cylinders, and he finds it scarcely one-half of the enormous load which the boilers are required to bear. Following then analogy from

universal experience, he attributes the faults to a supposed erroneous construction of valve and steam passages, which have been heretofore so far as we know never described in detail. Mr. Gilman denies the data, not the inferences, but we are sure that he will see the necessity of accumulating evidence against data got in such a way. The indicator is easily applicable; will he not take the trouble to have it applied on several of the boats (those named in McAlpine's report if possible,) and let us see and publish the cards. That, if fairly done, will settle the question.

It will then be time enough, if it be considered important, to discuss the structure and arrangements of the Western boats; but we now freely concede to Mr. G. that the high pressure boat appears to us the only one applicable to the peculiar navigation of the Mississippi, where low water, strong currents, and inconceivably muddy waters, render the condensing engine entirely inapplicable. We regret, moreover, the language which appears to have given offence; it was probably a hasty expression, which escaped the notice of our correspondent, as it did ours, or it would not have been inserted, for epithets, whether true or false, are of no service in a discussion of this kind.

We shall be glad to hear from Mr. Gilman again on this subject.

Ed.

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*Improved Lucifer Matches.**

Messrs. J. and E. Sturge, of Birmingham, are now manufacturing on a large scale, a new description of phosphorus for lucifer matches, (called amorphous phosphorus,) which possesses the following advantages over the old: 1, It involves much less risk of destruction of life and property by fire; 2, It is more suitable for matches intended for warm climates; 3, It is not poisonous in the solid form, as that matches made with it will be comparatively harmless if sucked or chewed; and, 4, It does not give off any noxious vapor at ordinary temperature.

The simplest lucifer match consists of a splinter of wood dipped into melted phosphorus, and then covered with gum or glue. More frequently phosphorus is associated with chlorate or nitrate of potass, and with sulphur or sulphuret of antimony. The employment of such materials necessarily renders the manufacture a very hazardous one, from the risk of fire, and in certain of the Continental states the preparation of lucifer matches has been absolutely prohibited. Another and quite unexpected hazard was soon found to attend their manufacture. The work people were attacked by a very painful and often fatal disease of the jaw-bones, which became carious, occasioning in many cases death, in several loss of the upper or under jaw, or other severe mutilation and disfigurement, and always much suffering. The German surgeons, who have paid great attention to this distressing disease, refer it to the absorption of the vapor of phosphorus, given off chiefly during the drying of the matches, but likewise at other stages of the manufacture. Phosphorus, also, is well known to act as a poison when swallowed in the solid form, and as it occurs in this condition in lucifer matches, fatal accidents have more than once occurred from children sucking them.

The red or amorphous phosphorus is much less combustible than ordi-

* From the London Mechanics' Magazine, June, 1852.

nary phosphorus, and not at all poisonous. To prepare the new substance, ordinary phosphorus is melted in a peculiarly constructed retort, and kept for some hours at a temperature of about 500° Fahr. A very singular change is the result of this heating, during which the phosphorus combines with caloric, and renders it latent, but does not otherwise undergo any chemical alteration. The original phosphorus is a pale yellow or white transparent body, so combustible that it must be kept under cold water, and when brought into the air grows luminous even at the freezing point, and enters into full blaze at a temperature of about 150° Fahr. By the prolonged heating it becomes a soft opaque mass, which is easily pulverised, and then forms an uncrystalline powder of a scarlet, crimson, purple-brown, or brown-black color, so incombustible that it may be exposed in summer in the open air, and handled with impunity; nor does it grow luminous till it is about to enter into full combustion at the temperature of 482° Fahr. It is further so harmless to living creatures, that more than a hundred grains have been given to dogs without doing them any injury. Although in its free state, it is sparingly combustible, yet, when it is mixed with the ordinary ingredients of lucifer matches, such as sulphur or sulphuret of antimony and chlorate of potass, it kindles readily.

On the Composition of Wootz, or Indian Steel. By T. H. Henry, Esq., F. R. S.*

The high degree of estimation in which wootz has been held in this country appears to rest more upon the supposition that the celebrated scimitars of Damascus were made from this variety of steel, than on any results obtained with it here; for notwithstanding the late Mr. Stodart, an eminent authority, was of opinion that wootz was superior for many purposes to any steel commonly used in this country, the attempts to bring it into use have not been successful, owing, it is said, to the difficulty of working it.

Under these circumstances, it appeared to me desirable to ascertain as accurately as possible the chemical composition of this steel, with the hope of throwing some light upon the causes of its peculiar physical properties.

An examination of wootz was made by Dr. Faraday in the year 1819.† The amount of carbon was not determined by him; the only substances eliminated were silica and alumina; and he obtained in two analyses 0·0128 and 0·0693 per cent. of aluminium.

From these results Messrs. Faraday and Stodart drew the conclusion, that the peculiar excellence of wootz depended chiefly upon the small quantity of aluminium combined or alloyed with the steel,‡ and this opinion appeared to be strongly supported by ingenious synthetical experiments.

On the other hand, Karsten could only detect dubious traces of aluminium in wootz, and Elsner§ attributed the improvement in the quality of the steel produced in Messrs. Faraday and Stodart's experiments, not to the small quantity of the foreign metals, aluminium, silver, platinum, &c.,

* From the London, Edinburgh, and Dublin Philosophical Magazine, July, 1852.
† Quarterly Journal of Science, vol. vii. ‡ Annales de Chimie, tome xv.
§ Journal fur Prakt. Chimie, vol. xx. p. 110.

alloyed with them, but entirely to the operation of remelting, and this seems to be the practical conclusion come to at Sheffield at the present day. The fact, however, of the perfectly damasked surface obtained in the alloys of Messrs. Faraday and Stodart so closely resembling that of wootz, seems to militate against the conclusions of Elsner.

M. Breant attributes the damask of the Eastern blades to the crystallization of two distinct compounds of iron and carbon, and draws a distinction between the oriental damask and that produced by alloys of steel. This opinion is confirmed by the experiments of M. Anocoff, a Russian engineer, published in the *Annuaire du Journal des Mines de Russie*, a few years back. He pretends to have produced blades so nearly emulating those of Damascus, as to allow of their being bent at a right angle, and capable of dividing a film of gauze floating in the atmosphere.*

I obtained from my friend, Mr. Trenham Reeks, of the Government School of Mines, two samples of wootz, furnished to him by Mr. Lewis Humbert, of the military department of the India House; one was in the form of a cake, such as would be produced by allowing the melted steel to cool in the crucible; the other was forged into a small bar, about four inches long and one inch square, and weighed 4760 grs., or rather more than 11 oz. These are the forms in which it is imported into this country. I preferred operating on the bar, for in steel in this form small particles of slag are often so intimately mixed with the metal as to defy separation; and it is possible, as all the alumina found by Dr. Faraday in wootz was in an insoluble form, that it might have existed as silicate of alumina.

The specific gravity of this specimen was 7·727 at 62° F. The composition was:—

	I.	II.
Carbon combined,	1·333	1·340
Carbon uncombined,	·312	·312
Silicium,	0·045	0·042
Sulphur,	0·181	0·170
Arsenic,	0·037	0·036
Iron,	98·092	98·100
	100·000	100·000

Cotton as an Element of Industry: its Confined Supply; and its Extending Consumption by Increasing and Improving Agencies. By Mr. Bazley.†

The lecture consisted of two parts, the first of which treated of the progress of the manufacture; the second, of the sources whence the raw material is supplied. The real commencement of the manufacture in England was at the beginning of the eighteenth century, at which period many causes had conspired to render the country fit for the reception of a new source of industry, and from that time to the middle of the century there was great activity in the domestic manufacture of both cotton and

* A specimen of his damask steel is to be seen in the Museum of the Government School of Mines in Jermyn street.

† From the London Athenæum, April, 1852.

sheep's wool. The weavers of those days had frequently to wait for the hand-spun yarn with which they worked, and hence many ingenious men began to direct their attention to the construction of machinery by which the supply might be increased. Thus, Wyatt, in 1730, discovered the principle of elongating fibre by rollers, and was followed by Hargreaves, Arkwright, Kay, Crompton, and others, the inventors of well known machines. The moving power of these machines had hitherto been the animal force of beasts of burden, or wind and water; but these could not be depended on, and it was reserved for steam to supply a prime mover of greater power and regularity than could be obtained from them. Great improvements were taking place during the same time in the methods of communication. In 1720, the waters of the Irwell and Mersey, between Liverpool and Manchester, had been rendered navigable and useful, in the teeth of the opposition of the pack-horse and wagon interest. In 1758 the Duke of Bridgewater engaged Brindley, the greatest Engineer of his day, to construct a canal for conveying the coal of the Worsley estate to the market of Manchester.

The lecturer here gave an interesting sketch of the labors of Brindley, and of the difficulties which had been overcome by the canals, and subsequently by the railways of England. He paid a just tribute to Lancashire, to the energy of which the first successful canal and railway were both owing. So, too, when gas was proposed for illuminating purposes, a Salford cotton spinner was the first to test its advantages on a large scale.

Mr. Bazley next called attention to the increase in the consumption of cotton wool in this country. At the commencement of the last century it was little more than 1,000,000 pounds weight per annum, while the work people employed on it did not exceed 25,000; but at the close of the century 52,000,000 pounds weight per annum were consumed, and the numbers employed were 125,000. Few articles are more generally applied in manufacture than cotton. Its finest qualities are worked into lace and muslin, while from its very waste excellent letter press paper is made. A very extensive trade has sprung up in Bradford, and other places, in "mixed goods," and "union cloths," which are composed of cotton in combination with worsted, silk, or thread. The cotton manufacture has had many variations, and under the restrictive policy it suffered great depressions, but since the alteration in the fiscal system of the country, a beneficial change has taken place, and the race is now free to all. During the past year, no less than 760,000,000 pounds weight of cotton were consumed in this country, passing through the hands of no fewer than 1,250,000 actual workers, or including their families, three millions and a half of our fellow subjects, an eighth of the population of the United Kingdom, while the exports in 1851 amounted to 30,000,000*l.* sterling. Some idea may be gained of the beneficial nature of this industry to the national treasury, from the fact that 12,000,000*l.* sterling, or one-fourth of the whole revenue, is contributed in taxes by those engaged in it, whilst the area occupied by their operatives is not more than one-hundredth part of the surface of the country. In treating the second part of his subject, Mr. Bazley drew attention to the singular fact, that although the British Colonies contain a greater extent of land suited to the growth of cotton than is to be found under any other dominion, yet that the sup-

ply derived from them is less in quantity and far inferior in quality; the supplies in 1851 were, from foreign countries, 1,569,800 bags; from the Colonies, 333,700 bags. And while 16,000,000*l.* were paid for the foreign cotton, only 2,000,000*l.* were realized by the Colonial. Of this large amount from foreign countries the great proportion comes from America; and individuals are now living who recollect the arrival of the first supplies in 1787; the value of the whole crop being now 30,000,000*l.*, equal to that of the wheat crop of this country. Surely this is a lesson to other countries possessing equally favorable conditions! The lecturer then glanced at the capabilities of the different British Colonies, for producing this material. The West Indian Islands, Port Natal, and our other African possessions were said to be capable of growing cotton quite as well as the United States; while Australia would produce an unlimited amount equal to the very finest. And lastly, there was the great colony of India, where this plant is indigenous, and where it has been known for 3000 years. The evidence of Dr. Royle, the Botanist of the East India Company, that India can yield an abundant supply of good and useful cotton, was quoted as a ground for the presumption that great blame attaches somewhere; since these expectations have never been realized except in a small degree at Guzerat. This part of the subject was closed by the remarkable statement that a piece of ground of the size of Yorkshire is sufficient to produce a quantity of cotton nearly double the annual consumption of England. It is not to be supposed that this trade is on the decline. One factory inspector, Mr. Horner, reports that in his district only, 81 mills have been started during the past year, employing 14,000 hands. Mr. Bazley then examined minutely the probability of the further and future progress of this great industry, and the means to be adopted to insure it: but into this it will be impossible to follow him in a brief abstract like the present. He concluded by an enumeration of the objects of interest, both in the department of machinery and of fabrics connected with the cotton manufacture, at the Great Exhibition; and with an expression of gratitude to his Royal Highness for having become the champion of arts, manufactures, and commerce, and to the Society of Arts for its share in promoting the success of the Exhibition.—*Proc. Soc. Arts, April* 3, 1852.

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*Iron Flowers.**

A "fancy piece" has been prepared for the Prussian Exhibition by the Renard Works; it is a vase of polished coal, as solid as black marble, holding a large bouquet of flowers made of sheet iron—leaves, petals, and stems, all perfectly graceful and natural, but sable as night. The effect is singular—the complete imitation having not the least resemblance to nature, unless there are such blossoms on the banks of Acheron: it is Flora in mourning.

* From the London Mining Journal, No. 876.